TEKTRONIX®

149
NTSC
TEST SIGNAL
GENERATOR

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97005

Serial Number _____

070-1374-00

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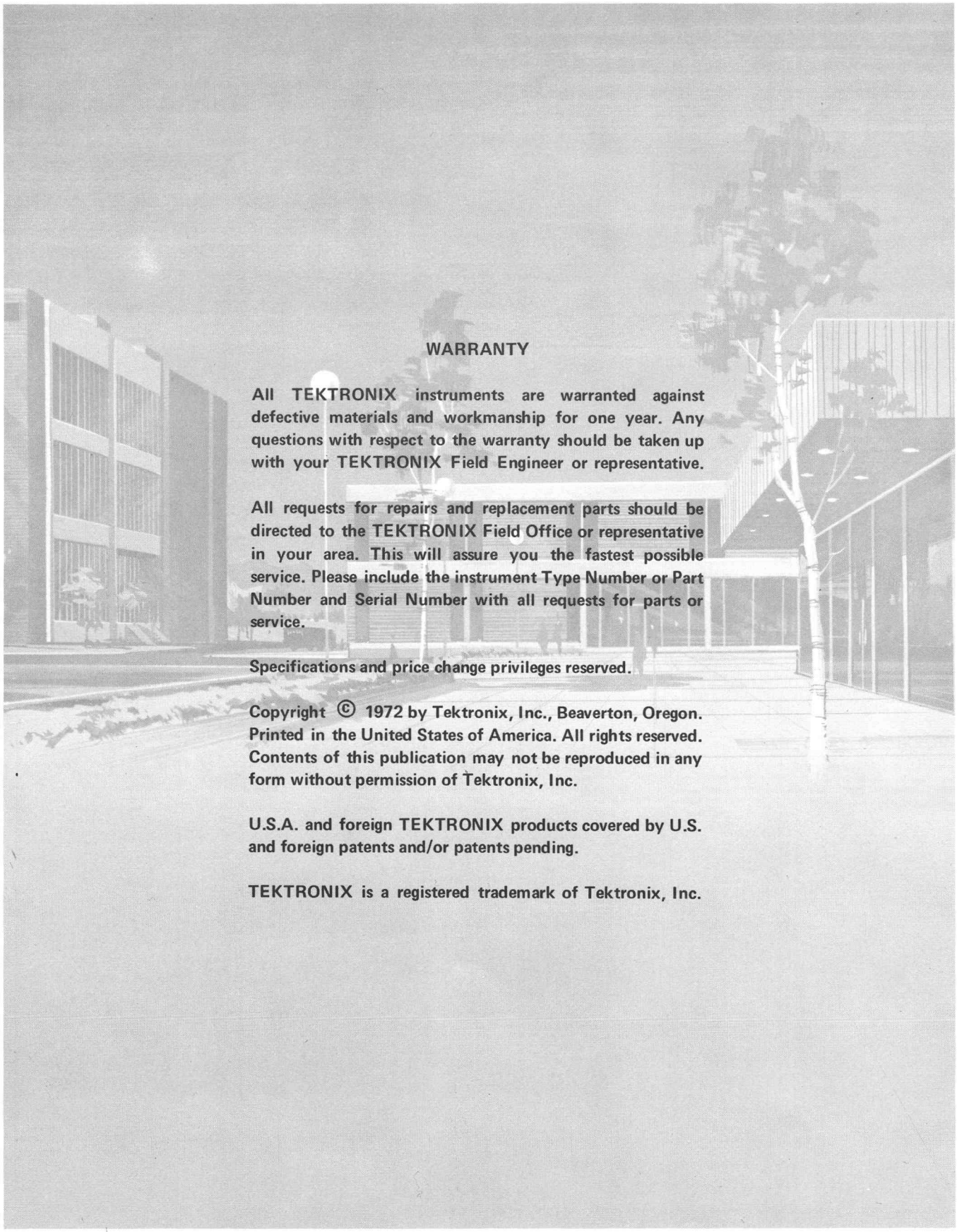


WARRANTY

All TEKTRONIX instruments are warranted against defective materials and workmanship for one year. Any questions with respect to the warranty should be taken up with your TEKTRONIX Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the TEKTRONIX Field Office or representative in your area. This will assure you the fastest possible service. Please include the instrument Type Number or Part Number and Serial Number with all requests for parts or service.

Specifications and price change privileges reserved.

U.S.A. and foreign TEKTRONIX products covered by U.S. and foreign patents and/or patents pending.

TABLE OF CONTENTS

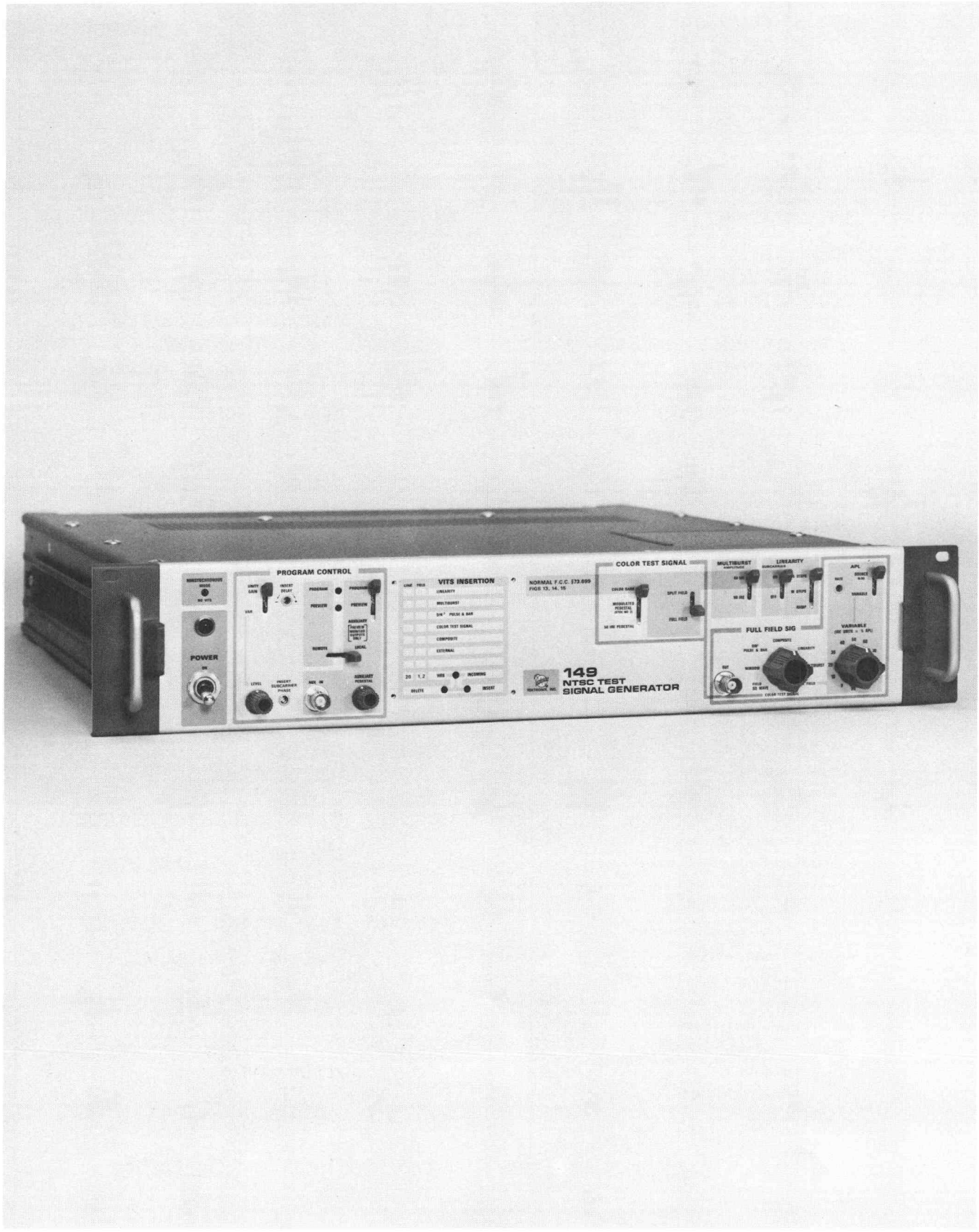


Fig. 1-1. The 149 NTSC Test Signal Generator.

SECTION 1
SPECIFICATION

General Information

The TEKTRONIX 149 NTSC[1] Test Signal Generator[2] is a compact, solid state instrument capable of supplying several test signals commonly used by the television industry for test and measurement of video transmission systems or discrete parts of the system. The generated signals are available as Full Field Composite Video test signals on one output, and as Vertical Interval Test Signals (VITS) inserted into the vertical blanking interval of an incoming composite video signal, appearing in combined form on another output.

In addition to the front-panel controls, there are extensive provisions within the instrument to permit selection of the test signal parameters and their time location within the vertical blanking interval. This flexibility is provided mainly through the use of pin connector changes, permitting simple and rapid change of selection without soldering procedures. All time locations of the test signals, within both the line and the field, are derived by digital counting from a master oscillator which, in turn, is locked to the incoming composite video if present. The 149 may be used in conjunction with a TEKTRONIX Type 140 NTSC Test Signal Generator to provide standard test signals with Gen-Locks[3] operation.

[1] National Television System Committee.

[2] The 149 is intended for rackmount installation; a bench model is available.

[3] Synchronization of signals in both frequency and phase.

Available Signals

The 149 generates MULTIBURST, LINEARITY, FLAT FIELD, FIELD SQ WAVE, WINDOW, SIN^2 PULSE & BAR, COMPOSITE, and either COLOR BARS in compliance with FCC[4] Rules and Regulations § 73.676 (f) for Remote Control Monitoring, or a three level chrominance bar (MODULATED PEDESTAL) in compliance with STOC[5] Test Signal No. 2 for use as Full Field Composite Video or VITS. The proposed VIRS (Vertical Interval Reference Signal) can be generated by the 149 and may be inserted on line 20 of either or both fields as internally programmed.

Fail Safe Operation

In the event of power failure, or the actuation of a remote bypass switch a relay switch routes the program signal around the instrument, by-passing all circuitry and thus providing fail-safe operation.

ELECTRICAL CHARACTERISTICS

Performance Conditions

Characteristics and their Performance Requirements described in this section are valid over the stated environmental range, for instruments calibrated at an ambient temperature between +20°C and +30°C. Instrument warm-up of five (5) minutes is required.

[4] Federal Communication Commission

[5] Satellite Technical and Operational Committee-Television

TABLE 1-1

Program Control System

Characteristic	Performance Requirement	Supplemental Information
Signal Input Level		
UNITY GAIN	Within 0.5% of Unity Gain	
VAR	1 V P-P within 30%	
Input Impedance	75 Ω nominal	
Input Return Loss		
POWER ON	At least 46 dB to 5 MHz	
POWER OFF or BYPASS	At least 40 dB to 5 MHz	
Output Impedance (all)	75 Ω nominal	
Output Return Loss (all)	At least 30 db to 5 MHz	
Video Delay		≈62° at subcarrier frequency
Output Blanking DC Level (all)	0 V within 50 mV	
Isolation		
PROGRAM & PREVIEW OUT		At least 46 dB to 5 MHz
PROGRAM & PROGRAM MONITOR OUT		At least 34 dB to 5 MHz
Inserted Signal Amplitude	Within 1% of nominal	
Amplitude Ratio		
2T Pulse to Bar Amplitude Ratio	Within 0.25%	
Mod Sin^2 Pulse (Chrominance + Luminance)	100% within 0.5%	
Waveform Tilt		
Field Rate Square Wave	0.5% or less	
25 μs Bar	0.5% or less	
Differential Phase (10-90 APL Standard Input)		
Program Output	0.15° or less	

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Differential Phase (cont) Preview Output	0.3° or less	
Differential Gain (10-90 APL, Standard Input) Program Output	0.2% or less	
Preview Output	0.4% or less	
Line Time Amplitude Non-Linearity	0.25% or less	
Random Noise Output Program Output	At least 75 dB (RMS) down	Using Weighted and Low Pass Filters (5 MHz)
Residual Subcarrier On Non-Inserted Lines	At least 60 dB down	Low Pass (5 MHz)
Hum or Transients On Non-Inserted Lines	At least 60 dB down	Using Weighted and Low Pass Filters (5 MHz)
Spurious Signals During Blanking (Inactive Line Time)	At least 40 dB down	Low Pass (5 MHz)
Signal Attenuation in "Delete" Mode 2T Pulse	At least 70 dB	
Subcarrier (color bars)	At least 60 dB	
Crosstalk Into Program Channel From Internal Signal 2T Pulse	At least 70 dB down	Low Pass (5 MHz)
Subcarrier (staircase)	At least 60 dB down	Low Pass (5 MHz)
Adjustment Range of Inserted Signal Blanking for use with External Sync		At least ±3 μs
INSERT DELAY Range	At least + and −0.5 μs (1 μs total)	
Time Jitter		5 ns or less
Unwanted Pedestal at Time of VITS Insertion	0.7 IRE or less	

TABLE 1-2

Test Signal Elements
(VIT or FULL FIELD)

Characteristic	Performance Requirement	Supplemental Information
MULTIBURST Signal		
White Ref Amplitude	100 IRE within 1 IRE	
Burst Amplitude		
90 IRE	90 IRE (P-P) within 1 IRE	
60 IRE	60 IRE (P-P) within 1 IRE	
Average Level		
90 IRE	55 IRE within 1 IRE	
60 IRE	40 IRE within 1 IRE	
Burst Frequencies	0.5 MHz within 3%	
	1.25 MHz within 3%	Adjustable range to 1.5 MHz
	2.0 MHz within 3%	
	3.0 MHz within 3%	
	3.58 MHz within 3%	
	4.1 MHz within 2%	
Burst Harmonic Content	−40 dB	
Burst Timing	Each burst starts at 0° and consists of a whole number of cycles	
LINEARITY Signal		
Staircase Signal		
Luminance		
Amplitude		
10 Step	90 IRE within 1 IRE	
5 Step	80 IRE within 1 IRE	
Riser		
5 and 10	Amplitude of each riser is within 1%	
Risetime (All identical)	250 ns within 15%	
Chrominance		
Frequency		
Free Run	3.579545 MHz within 25 Hz	
Locked Mode	Locked to incoming burst	
Amplitude	40 IRE	Within 0.5 IRE
Inherent Differential Gain	0.5% or less	
Inherent Differential Phase	0.2° or less	
Envelope Rise and Fall Times	≈375 ns	
Residual Subcarrier On Insertion Lines		0.5 IRE or less
Timing	Waveform transitions determined by characteristic instants (see Fig. 1-2)	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Ramp Signal		
Amplitude	90 IRE	Within 1 IRE
Linearity	Within 1%	
Timing	(See Fig. 1-2)	
SIN^2 PULSE: 2T or T, and Integrated Sin^2 Pulse (Bar) 2T or T Signal		2T Pulse, 2T Bar Factory programmed
2T Pulse		
Pulse to Bar Ratio	0.25% or less	
Half Amplitude Duration	250 ns	Determined by 9 Pole Kastelein[6] Filter
Ringing Amplitude	0.5 IRE or less	
Ringing Duration Timing	(See Fig. 1-2)	4 cycles or less (determined)
2T Bar		
Risetime	250 ns	Within 15%
Amplitude	100 IRE	Within 1 IRE
Timing	(See Fig. 1-2)	
T Pulse	0.125 μs HAD	Determined by 9 Pole Kastelein Filter
T Bar		
Amplitude	100 IRE within 1 IRE	
Risetime	115 ns	Within 15%
Duration and Timing	(See Fig. 1-2)	
MODULATED SIN^2 PULSE	12.5T or 20T	20T pulse also available by internal jumper connection. Factory connected for 12.5T
Amplitude of Luminance Component	50 IRE	
Amplitude Difference of Peak Chrominance to Peak Luminance	0.5 IRE or less	
Chrominance-Luminance Delay	5 ns or less	
HAD (Half Amplitude Duration) of 12.5T	1.57 μs	Within 75 ns
HAD (Amplitude Duration) of 20T	2.5 μs	Within 0.1 μs
Residual Subcarrier on Insertion Line	0.5 IRE or less	
Harmonic Content of Subcarrier	−40 dB or greater	
Phase		
VIT Range	0° to 360°	May be used for identification purposes
FULL FIELD	Phase modulated at field rate	

[6] A. Kastelein, "A NEW SINE-SQUARED PULSE and BAR-SHAPING NETWORK", IEEE Transactions of Broadcasting, Volume BC-16, Number 4, Dec. 1970 (pp 84-89).

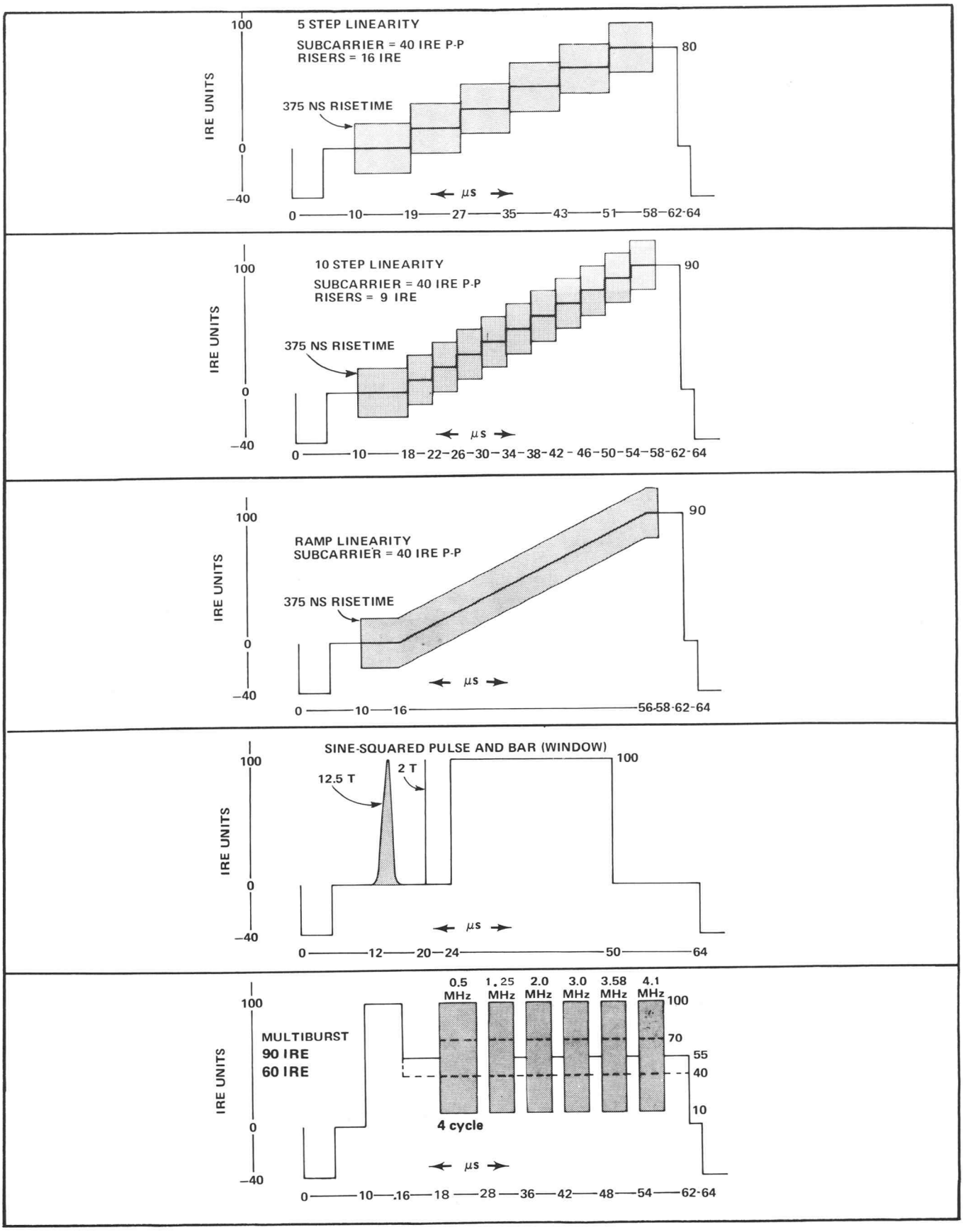


Fig. 1-2. Test signal output timing details.

REV. B, MAR. 1975

Fig. 1-2. Test signal output timing details. (cont)

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
WINDOW Signal		
Risetime	Same as Bar	
Amplitude	Same as Bar	
Duration	26 μs/line X 152 lines	Lines 66 through 218
COMPOSITE Signal		
Linearity Test Signal	Same as full line 5 steps staircase except for duration (see Fig. 1-2)	
Sin^2 Pulse	Same as Full Line signal	
Modulated Sin^2 Pulse	Same as Full Line signal	
Sin^2 Bar	Same as Full Line signal	
FLAT FIELD Signal		
BOUNCE (10-90 APL)	Automatic bounce between 10 and 90 IRE	Within 2 IRE
RATE	≈1 second to greater than 10 seconds	
VARIABLE	11 levels, equal within 2%	
Risetime	≈230 ns	
Time Location		Active portion of line (see Fig. 1-2)
FIELD SQ WAVE Signal		
Amplitude Relative to White Reference	100 IRE within 2 IRE	
Lines White	Lines 57 through 227 (each field)	
Lines at Blanking	All other active lines	
Risetime	230 ns	
COLOR TEST SIGNAL		
Luminance and Chrominance	Absolute amplitudes of luminance signal, set-up, and sync are within 1% or 1.5 mV, whichever is greater, with respect to blanking.	
	Absolute amplitudes of all subcarrier frequency components (B-Y, R-Y) are within 3%.	
	With the red chrominance bar as an absolute reference, all other subcarrier frequency component amplitudes are within 1% or 1 mV plus the peak to peak residual subcarrier amplitude, whichever is greater, of their assigned values listed below.	
Blanking Level (With respect to ground)	0 volts within 50 mV	

75% Amplitude 7.5% Setup	Millivolts			
	Lum	**Chroma (P-P)**	**B-Y (P-P)**	**R-Y (P-P)**
White	714.3	2.5 or less	----	----
Yellow	494.6	445.1	434.7	95.6
Cyan	400.4	625.9	146.5	608.5
Green	345.9	588.3	288.2	512.9
Magenta	256.7	588.3	288.2	512.9
Red	202.2	625.9	146.5	608.5
Blue	108.1	445.1	434.7	95.6
Black	53.6	2.5 or less	----	----

TABLE 1-2 (cont)

Characteristics	Performance Requirement				Supplemental Information
COLOR TEST SIGNAL (cont)	Millivolts				
75% Amplitude 7.5% Setup (cont)	**Lum**	**Chroma (P-P)**	**B-Y (P-P)**	**R-Y (P-P)**	
Blanking Level	0	2.5 or less	- - - -	- - - -	
Sync	−285.7	2.5 or less	- - - -	- - - -	
Burst	0	285.7	285.7	0	
Chrominance Time Difference Between Luminance and Chrominance	20 ns or less				
B-Y, R-Y Quadrature Error	0.5° or less				
R-Y Axis Phase Switcher	0.5° or less				
Residual Subcarrier	At least 52 dB below 1 V on White, Black				2.5 mV peak to peak or less
Aberrations Spurious Subcarrier	Within 4% P-P of 1 V At least 52 dB below 1 V when viewed on TEKTRONIX Type 529, except 30 dB at the end of H blanking				
Other Spurious Outputs	At least 52 dB below 1 volt, when viewed on a TEKTRONIX Type 529, except 30 dB down during sync and at the end of H blanking.				
COLOR BARS	VIT Color Bar as per FCC Rules and Regulations Fig. No. 14, § 73.699.				See Fig. 1-2
Luminance Risetime	250 ns within 50 ns				Determined by Sine-Squared Filter
Chrominance Risetime	400 ns within 15%				
Bar Duration					
White Flag	8 μs				
Color and Black	8 μs				
Reference					
Timing					
SPLIT FIELD					
Luminance Component	All active lines				
Chrominance Component	All active lines programmed for "WINDOW" signal				Lines 66-218 of each field
FULL FIELD	All active lines				
MODULATED PEDESTAL					
Pedestal					
Amplitude	50 IRE within 0.5 IRE				
Risetime	250 ns within 50 ns				
Tilt	0.3% or less				% of Pedestal Amplitude
Timing	See Fig. 1-2				Full line or half-line available.
Chrominance Levels					
20 IRE	20 IRE peak to peak				Within 1%
40 IRE	40 IRE peak to peak				Within 1%
80 IRE	80 IRE peak to peak				Within 1%
0 IRE	2.5 mV peak to peak or less				

TABLE 1-2 (cont)

Characteristics	Performance Requirement	Supplemental Information
Chrominance Phase		
Relative to Burst	90° within 1.0°	
Relative to Phase of other two levels	0° within 0.2°	
Harmonic Distortion		Less than 1%
Risetime of Modulated Envelope	375 ns within 50 ns	

TABLE 1-3

Vertical Interval Reference Signal

Characteristic	Performance Requirement	Supplemental Information
Vertical Interval Reference Signal (VIRS)		
Chrominance Reference		
Amplitude	40 IRE	Within 0.4 IRE
Phase	180°	Adjusted with front-panel INSERT SUBCARRIER PHASE control.
Timing	See Fig. 1-2	
Envelope Risetime	1 μs	Within 15%
Average Level of Chrominance Signal	70 IRE	Within 0.7 IRE
Luminance Reference		
50 IRE Level	50 IRE within 0.5 IRE	
Black Reference	7.5 IRE within 0.5 IRE	

TABLE 1-4

Full Field Output

Characteristic	Performance Requirement	Supplemental Information
Full Field Test Signal Outputs		
Amplitude Relative to Inserted Signals of Same Type	Within 1% (both outputs)	
Return Loss	At least 30 dB	
Sync and Burst Timing	See Fig. 1-3 and 1-4	
CW SUBCARRIER		
Amplitude	2 volts peak to peak	Within 0.2 V
COMPOSITE SYNC		
Amplitude	4 volts peak to peak	Within 0.2 V

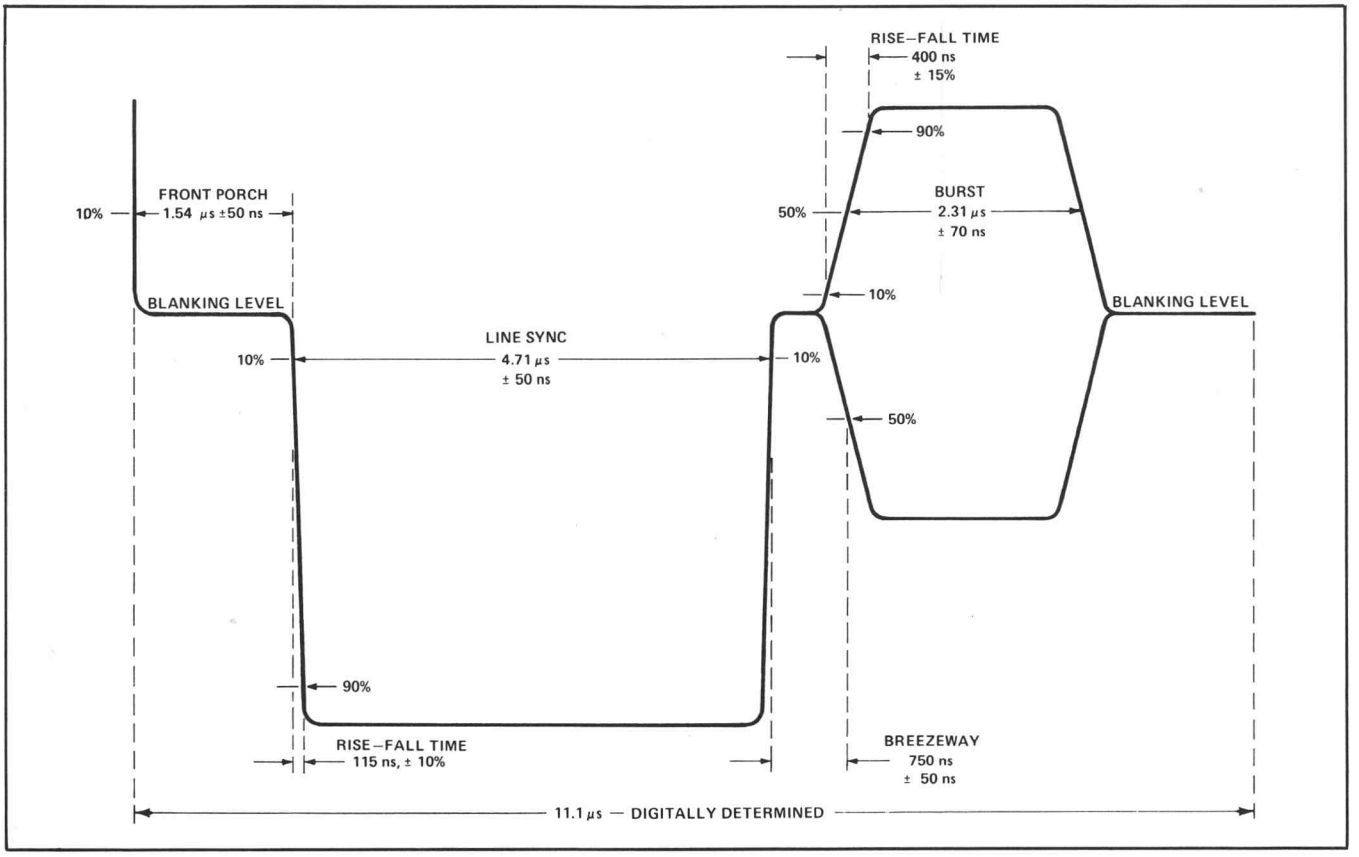


Fig. 1-3. Horizontal blanking details.

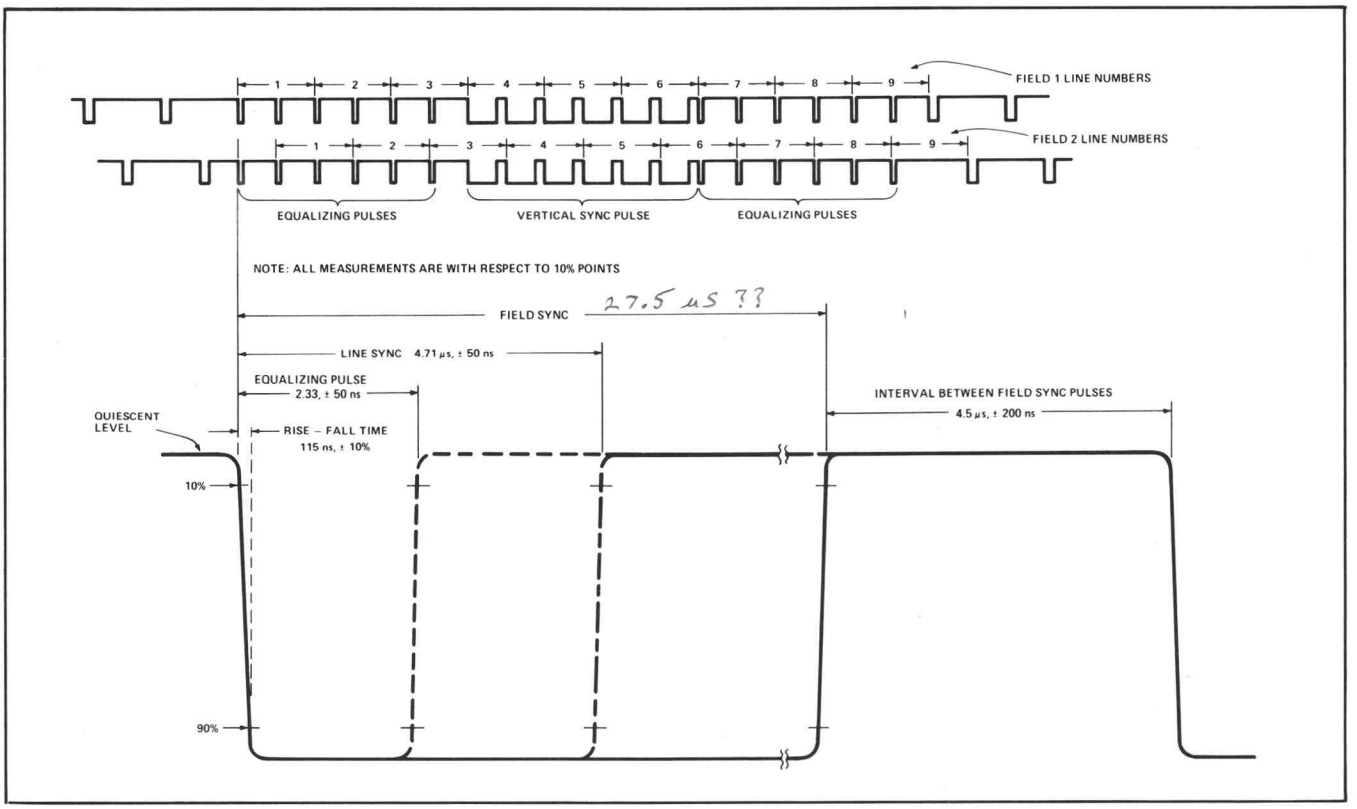


Fig. 1-4. Composite Sync blanking details.

TABLE 1-5

Power Supply

Characteristic		Performance Requirement	Supplemental Information
Line Voltage Range			
115 VAC	Low		90 V to 110 V
	Medium	104 V to 125 V	
	High		112 V to 136 V
230 VAC	Low		180 V to 220 V
	Medium		208 V to 252 V
	High		224 V to 272 V
Crest Factor			At least 1.35
Maximum Line Current		0.5 A	
Maximum Power Consumption		40 W	
Line Frequency Range		48 to 66 Hz	

TABLE 1-6

Physical

Characteristic	Information	
Finish	Cabinet is blue-vinyl painted. Front panel is anodized aluminum.	
Dimensions	Rackmount	Bench Model
Overall		
Height	3.47 inches	3.82 inches
Width	19.0 inches	18.225 inches
Length	19.66 inches	19.1 inches
Cabinet		
Height	----------	3.47 inches
Width	16.88 inches	17.1 inches
Length	18.41 inches	18.41 inches
Width Over Sides	17.625 inches	----------
Length with BNC-T	18.6 inches[7]	18.91 inches[8]

[7] 18.67 inches with BNC Cable to Connector

[8] 18.98 inches with BNC Cable to Connector

ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local TEKTRONIX Field Office or representative.

ACCESSORIES

Standard accessories supplied with this instrument are listed in the Mechanical Parts List.

TABLE 1-7

Environmental

Characteristic	Information
Temperature	
Non-Operating Range	−40°C to +65°C
Operating Range	0°C to +50°C
Altitude	
Non-Operating Range	To 50,000 feet
Operating Range	To 15,000 feet

SECTION 2
OPERATING INSTRUCTIONS

General

This section of the manual is intended to provide the operator with information necessary for proper operation of the 149. Included are (1) Initial Installation, information dealing with the various line voltages that may be used to power the instrument, and information regarding Local or Remote operation; (2) Controls and Connectors, a brief discussion of each control and connector; (3) Basic Information, dealing with the different signals generated by the 149 and how they might be used; (4) First Time Operation, a complete step-by-step procedure using each control and connector; (5) Operating Changes, dealing with all internal changes that can be made for different applications; (6) Remote Control Monitoring; and (7) Glossary of Terms.

We recommend that the user of this instrument refer to the following reference material as a supplementary source of information.

Television Systems Measurements, MEASUREMENTS CONCEPT BOOK, First Edition (March, 1969), Tektronix, Inc.

Television Products Application Notes, Tektronix, Inc.

Television Signal Analysis, Second Edition (April, 1963). American Telephone and Telegraph Company Long Lines Department (Revised by Network Transmission Committee of the Video Transmission Engineering Advisory Committee).

INSTALLATION

WARNING

The instrument is intended to be operated from a single-phase power source which has one of its current carrying conductors (The Neutral Conductor) at or near ground (earth) potential. Operation from other power sources where both current carrying conductors are live with respect to ground (such as phase-to-phase on multi-phase systems) is not recommended, as only the Line Conductor has over-current (fuse) protection within the instrument.

Operating Voltage

The 149 may be operated from either 115-VAC or 230-VAC (nominal) line voltage source. Quick-change line-voltage plugs, located under the fuse cover on the rear panel, change the transformer primary connections so that the instrument will operate from one line voltage or the other (115 V or 230 V). In addition, the plugs permit one of three line voltage operating ranges to be selected. Table 2-1 lists the voltage ranges that enable the instrument DC power supplies to regulate properly.

To convert to a different line voltage, proceed as follows:

1. Disconnect the 149 from the power source.

2. Unscrew the two captive screws holding the fuse cover. Remove the cover and attached fuses.

3. Pull out the 115/230 Voltage Selector plug (see Fig. 2-1), then rotate the plug 180° and insert it into the opposite set of holes. The 115/230 Voltage Selector plug is located in the upper position for 115 V operation, and in the lower position for 230 V operation.

4. To change the line-voltage operating range (LO, M, or HI), pull out the Range Selector plug (see Fig. 2-1) and insert it in the desired hole locations. Select a range with a center voltage (see column three in Table 2-1) closely corresponding to the line voltage that will be applied in regular instrument operation.

TABLE 2-1

115/230 Voltage Selector Plug Position	Range Selector Plug Position	Nominal Line (Center) Voltage	Line Voltage Plug Range[1]
115 V	LO (Low)	100 VAC	90 to 110 VAC
	M (Medium)	115 VAC	104 to 126 VAC
	HI (High)	124 VAC	112 to 136 VAC
230 V	LO (Low)	200 VAC	180 to 220 VAC
	M (Medium)	230 VAC	208 to 252 VAC
	HI (High)	248 VAC	224 to 272 VAC

[1] **Applicable when the line contains less than 2% total distortion.**

5. Re-install the cover with two captive screws and fuses. Be sure the cover fits firmly against the rear panel. This indicates that the line fuses are seated properly in the fuse clips.

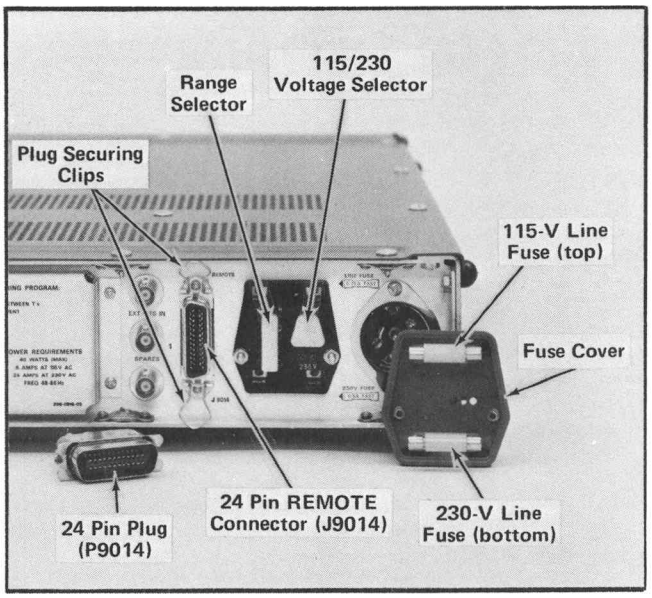


Fig. 2-1. Location of Range and Voltage Selector plugs with fuse cover removed (plugs as shown are set for 115-V medium range operation). Also shown is the REMOTE (J9014) connector, Plug (J9014), and plug securing clips.

6. Before applying power to the instrument, check that the indicating tabs on the selector plugs protrude through the proper holes in the cover for the correct line voltage and the proper operating range.

CAUTION

The 149 should not be operated with the 115/230 Voltage Selector and/or Range Selector plugs in the wrong position for the line voltage applied.

Local-Remote Connector

The 149 may be operated by local or remote means. (Local refers to 149 operation from the front panel.) A multi-pin connector, REMOTE J9014 (see Fig. 2-1), is incorporated on the rear panel. Installed to this, is a REMOTE plug (P9014,TEKTRONIX Part No. 131-0325-00). This plug is factory wired for LOCAL operation, see Fig. 2-2.

To operate Remote, separate switching must be used at the remote location(s). In addition, the multi-pin plug must be wired accordingly. Fig. 2-3 shows the external switching required for remote control of FULL FIELD, VIRS, PROGRAM, or VITS. The external switching may be separate or combined to be controlled by one operator. Once the necessary wiring is complete, reconnect the plug to the REMOTE connector (J9014) and lock into place with the two securing clips shown in Fig. 2-1.

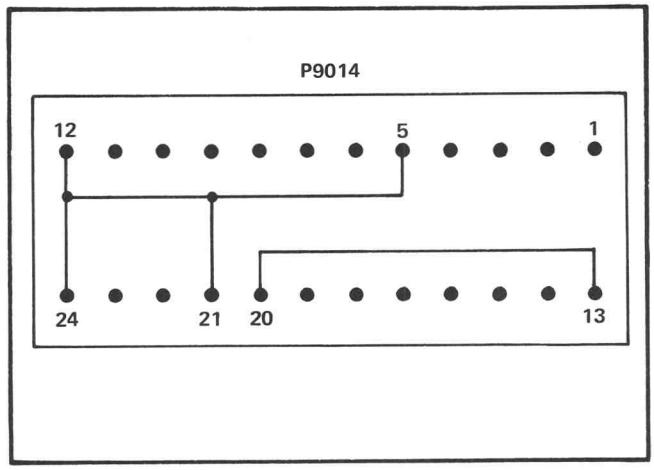


Fig. 2-2. Wiring diagram of Remote Plug for LOCAL operation (factory connected).

NOTE

Pin 6 of the REMOTE connector can be used (not dependent upon Local or Remote operation) as an Input or Output as follows:

OUTPUT—With no burst to the 149 PROGRAM LINE IN or BLACK BURST IN, Pin 6 will be 0 volts.

With burst to the 149 PROGRAM LINE IN or BLACK BURST IN, Pin 6 will be +5 volts.

INPUT—With Pin 6 grounded (⏚), subcarrier will be available at the rear-panel CW SUBCARRIER OUTPUT at all times.

With Pin 6 open (not connected), subcarrier will not be available at the rear-panel CW SUBCARRIER OUTPUT with loss of incoming burst at either the PROGRAM LINE IN or BLACK BURST IN.

CONTROLS AND CONNECTORS

Introduction

The following describes the function or operation of the 149 controls and connectors. Refer to Fig. 2-4 for locations of the controls and connectors.

Front-Panel Controls

POWER	Toggle switch to turn instrument power ON and OFF. Lamp indicates when POWER switch is ON and the instrument is connected to a line voltage source.

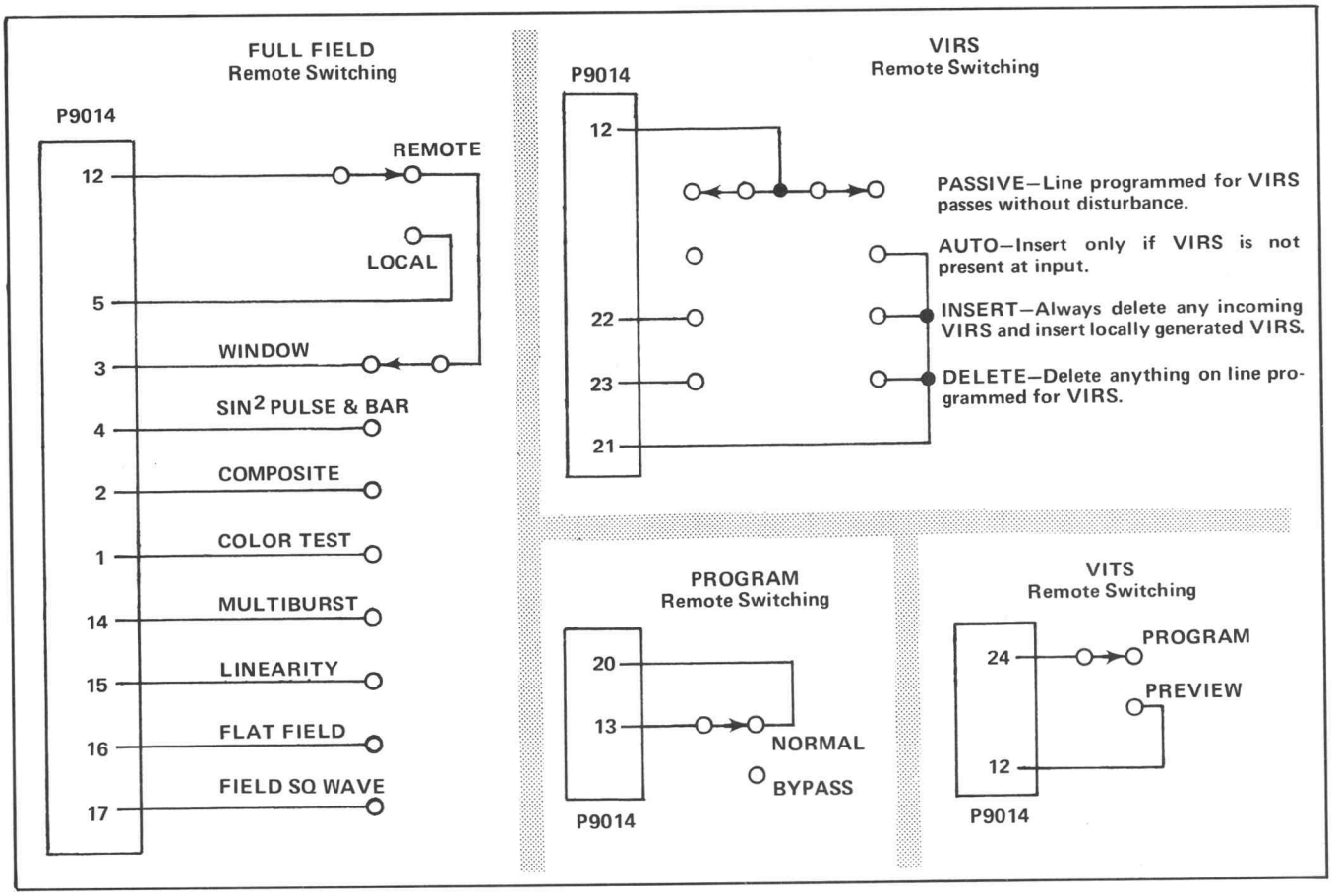


Fig. 2-3. Wiring diagrams for REMOTE operation.

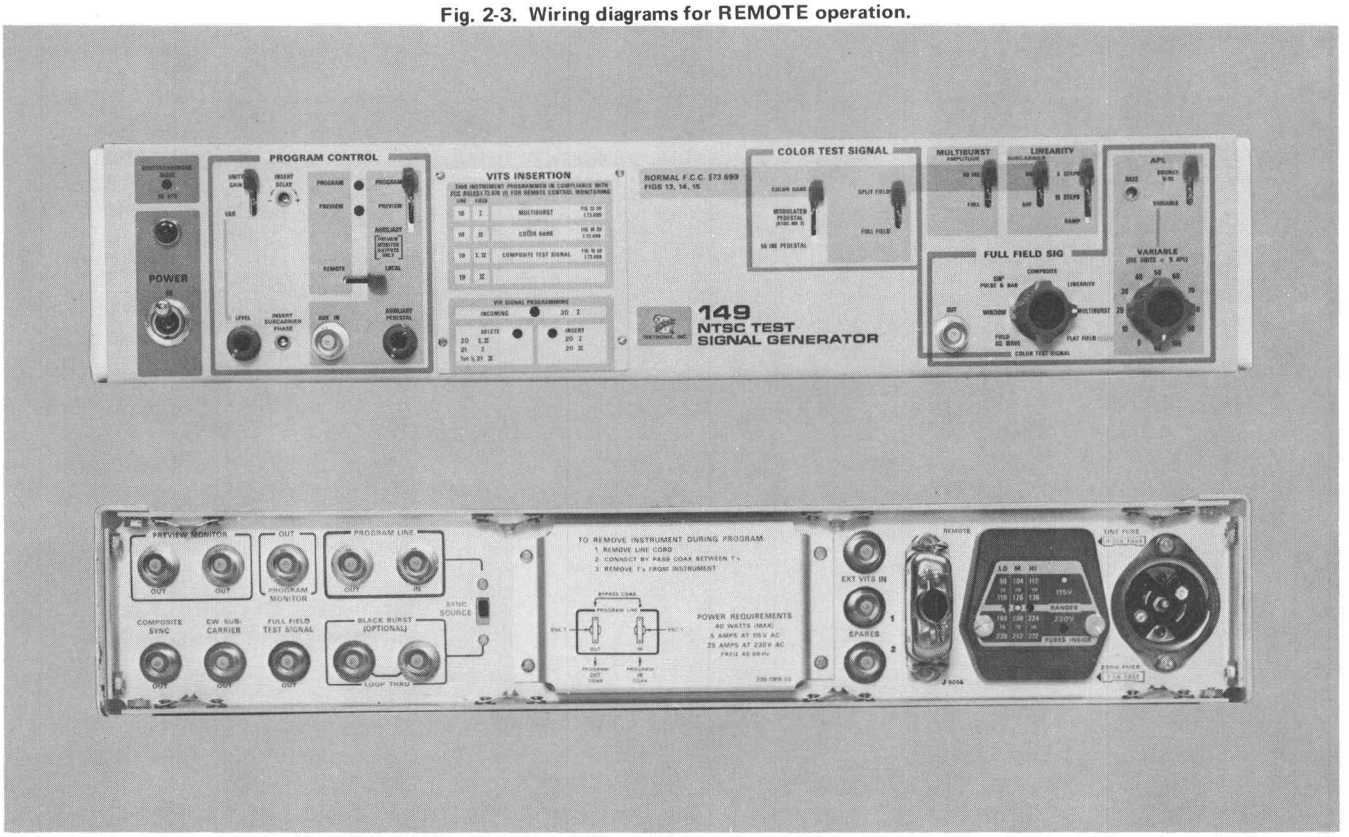


Fig. 2-4. 149 front- and rear-panel controls and connectors.

NONSYNCHRONOUS MODE-NO VITS — Lamp indicates absence of incoming synchronizing information (e.g., no externally applied composite video or black burst). In this state, no VITS will be added. Full Field signals are generated, but subcarrier free runs at approximately 3.58 MHz; line and field sync are mutually coherent, but not with subcarrier.

PROGRAM CONTROL — Consists of three lever switches, four variable controls, and two indicator lamps to (1) set the level of program and auxiliary pedestals, (2) select control of signal modes, and (3) indicate operating status.

UNITY GAIN/ VAR — Two position lever switch to select unity gain between PROGRAM INPUT and PROGRAM OUTPUT or control of gain by adjustment of LEVEL control.

LEVEL — Control to adjust gain between PROGRAM INPUT and PROGRAM OUTPUT when UNITY GAIN/VAR switch is in VAR position.

INSERT DELAY — Control allows adjustment to control time positioning of internally generated VITS with respect to the incoming signal.

INSERT SUB-CARRIER PHASE — Front-panel screwdriver adjustment to control phase of the color subcarrier on internally generated signals to match the phase of the incoming burst signal.

LOCAL/ REMOTE — Two position lever switch to select control of PROGRAM or PREVIEW modes from the front panel (Local) or from a remote location. Remote operation is controllable by connection of a remote switching circuit to the rear panel. This switch controls only this function of the remote.

PROGRAM/ PREVIEW/ AUXILIARY — Three position lever switch to select one of the following modes:

PROGRAM — VITS are inserted on the PROGRAM LINE, PROGRAM MONITOR, and PREVIEW MONITOR OUTPUTS according to internal selection of test signals and their time address.

PREVIEW — VITS are inserted on PREVIEW MONITOR OUTPUT only.

AUXILIARY — Permits the use of non-video signals at the AUXILIARY INPUT (such as a sweep generator or non-composite video signal). This signal appears at the PREVIEW MONITOR OUTPUTS with composite blanking and sync added; operates as a sync and blanking adder. This mode is not available in REMOTE (the program signal is bypassed through the relay).

AUXILIARY PEDESTAL — Control provides a DC offset so that auxiliary signal excursions may be positioned between the black and white levels of the resulting composite video signal.

PROGRAM/ PREVIEW LAMP — Lamps to indicate status. Required since the PROGRAM/PREVIEW/ AUXILIARY switch may not indicate actual operating mode when in REMOTE. Both lamps not lit indicates relay is not energized.

VITS INSERTION — Consists of a front-panel array of write-in spaces where the internal line and field addresses of the VIT signals may be indicated, and three lamps to indicate status of a VIRS. (A cover plate for this area designates the time address for the several signals as shipped from the factory.)

VIRS INCOMING — Lamp indicates the presence of a VIRS on the incoming composite video signal (Green).

VIRS DELETE — Lamp indicates that any signal on line programmed for VIRS is being deleted (Red).

VIRS INSERT — Lamp indicates that internally generated VIRS is being inserted on line programmed for VIRS (Yellow).

NOTE

Control of VIRS DELETE and VIRS INSERT function is by remote selection. Selection includes:

PASSIVE—Line programmed for VIRS passes without disturbance.

INSERT—Always delete any incoming VIRS and insert locally generated VIRS.

AUTO—Insert only if VIRS is not present at input.

DELETE—Delete anything on line programmed for VIRS.

COLOR TEST SIGNAL — Consists of two lever switches to select type of color test signal as VITS or FULL FIELD.

COLOR BARS — With lever switch in this position, color bars in accordance with FCC Rules and Regulations § 73.699 are provided.

SPLIT FIELD (FULL FIELD ONLY) — In this position, luminance component of color bars on all active lines. Chrominance component of color bars added during those lines which are programmed to generate "WINDOW" signal (lines 66-281).

FULL FIELD (FULL FIELD ONLY) — In this position, luminance and chrominance components of color bar on all active lines.

MODULATED PEDESTAL — With lever switch in this position, three levels of color subcarrier superimposed on a luminance pedestal is provided. Test signal in accordance with STOC (Satellite Technical and Operational Committee) Test Signal No. 2.

50 IRE PEDESTAL — With lever switch in this position, all active lines at 50 IRE.

FULL FIELD SIG — Consists of two rotary and one lever switch to select the type of test signal available at the OUT (or rear-panel FULL FIELD TEST SIGNAL) connector and to select the type of control over the FLAT FIELD signal.

FULL FIELD Mode — Eight position rotary switch to select one of the following signals to appear at the OUT connector: MULTIBURST, LINEARITY, FLAT FIELD, FIELD SQ WAVE, WINDOW, SIN^2 PULSE AND BAR, COMPOSITE, or COLOR TEST SIGNAL.

APL — Two position lever switch to control APL of FLAT FIELD signal.

BOUNCE 10-90 — In this position, the active portion of the line automatically bounces between 10 IRE and 90 IRE at a repetition rate determined by the RATE control.

RATE — Front-panel screwdriver control to set repetition rate of bounce from ≈1 to greater than 10 seconds.

VARIABLE — In this position, the level of the active portion of the line is selectable as determined by the VARIABLE switch.

VARIABLE — 12 position rotary switch used to select the level of the active portion of the line in 10 IRE steps from 0 to 100 IRE.

MULTIBURST AMPLITUDE — Two position lever switch to select peak to peak amplitude of MULTIBURST signal.

60 IRE — In this position, the peak to peak amplitude of multiburst will be 60 IRE centered about the 40 IRE level.

90 IRE — In this position, the peak to peak amplitude of multiburst will be 90 IRE centered about the 55 IRE level.

LINEARITY	Consists of two lever switches to control the LINEARITY test signal.
SUBCARRIER ON	Subcarrier is added to 5 step, 10 step, or Ramp signal. (Subcarrier is in phase with incoming color burst.)
OFF	Subcarrier is removed from LINEARITY and COMPOSITE staircase signals.
5 STEP/ 10 STEP/RAMP	Three position lever switch to select type of LINEARITY test signal.
5 STEP	LINEARITY signal consists of the 5 step staircase.
10 STEP	LINEARITY signal consists of the 10 step staircase.
RAMP	LINEARITY signal consists of the Ramp.

Rear-Panel Control

SYNC SOURCE	Two position lever switch to select either the PROGRAM LINE IN or BLACK BURST IN signal as sync source.

Input Connectors — All input signals (except remote plug) are via BNC type connectors.

AUX IN (1 front panel)	75 Ω input for non-video type signals.
BLACK BURST (2 rear panel)	High impedance loop-thru connection compensated for 75 Ω.
EXT VITS IN (1 rear panel)	75 Ω input, added to composite video, output to deleter and inserter circuit. Must not have VITS on the lines programmed for other 149 VITS. (Must not have sync and burst if not disconnected when AUXILIARY is used.)

Output Connectors — All output connectors are BNC type with 75 Ω impedance.

PROGRAM LINE OUT (1 rear panel)	Program output signal, with VITS added or not, according to PROGRAM CONTROL. Connected to PROGRAM LINE IN through relay in BYPASS or POWER OFF modes.
PROGRAM MONITOR (1 rear panel)	Same as PROGRAM LINE OUT except when relay is in BYPASS or AUXILIARY mode.
PREVIEW MONITOR (2 rear panel)	Always has VITS added and may have AUXILIARY added.
FULL FIELD TEST SIGNAL (1 front and 1 rear panel)	Full Field test signal.
CW SUBCARRIER (1 rear panel)	Regenerated subcarrier signal, ≈2 volts peak to peak.
COMPOSITE SYNC (1 rear panel)	Reprocessed sync signal, ≈4 volts peak to peak.

GENERAL INFORMATION

Television signals are complex waveforms. For this reason many test units are required to check one characteristic or another of the video system. The 149 is one such test unit; but it differs from others, in that it will provide complete time domain testing of a video system. All signals generated are controlled by a digital programmer which is Gen-Locked (normally), but may operate from its own oscillator. The following signals are generated by the 149:

MULTIBURST—Generated by a function generator and controlled by a digital programmer, this signal consists of a white flag (100 IRE) and six discrete packets of burst frequencies from 0.5 to 4.1 MHz. Each burst packet may be set for an exact number of cycles, regardless of the frequency. Multiburst is generally used for quick gain vs. frequency verification.

LINEARITY—Staircase, either 5 or 10 step, or ramp is available. Subcarrier (phase locked to burst) modulates either the staircase or ramp, and may be turned off by a front-panel control. Measurement of Differential Gain and Differential Phase may be made using the LINEARITY signal.

SIN^2 PULSE AND BAR—Sin^2 Pulse and Bar waveforms (2T and T) are generated to 9 pole Kastelein Filters[2]. The digital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter. The programmer also exactly determines pulse to pulse spacing and bar width. However, the programmer may be reprogrammed, to produce different spacing or bar widths in 2 μs increments should the need arise. Application includes K Factor measurements for short time distortions. (For K Factor measurements see: Television video transmission measurements, by L.E. Weaver, Marconi Instruments Limited, St. Albans, Hertfordshire England.)

The 12.5T Modulated Sin^2 Pulse has a 1.57 μs HAD, with the envelope of the Modulated Sin^2 Pulse formed in the function generator rather than in a filter. This allows programming for any desired pulse width from 1.5 μs to 2.5 μs. This signal is generally used to measure relative gain and delay errors between chrominance and luminance. (A TEKTRONIX 137 Chrominance/Luminance Gain Normalizer, designed for use with a modulated sine-squared pulse, can be used to facilitate these measurements.)

WINDOW—This signal is the standard Window signal now being used within the industry, with the exception that the Modulated Sin^2 Pulse and Bar has been added. Generally used with a picture monitor to observe streaking, etc., it is also used to check for both line and field time distortions.

FIELD SQ WAVE—This signal, similar to the WINDOW signal, has lines 66 through 218 of each field at 100 IRE, thereby simulating a 60 Hz squarewave, capable of passing through clamper amplifiers. It is used for accurate measuring of field time distortions.

FLAT FIELD—This composite video signal has, during the active portion of each field, a luminance level variable from 0 to 100 IRE in 10 IRE increments, or which bounces automatically between 10 and 90 IRE at a repetition rate of ≈1 to 10 seconds. It is used to test clamper amplifiers and systems in general, for APL dependent distortions.

COLOR BARS—75% Amplitude, 100% Saturated Color Bars with 7.5% Setup are generated by the 149. These color bars are in compliance with FCC Rules and Regulations 73.676 (f) for Remote Control Monitoring. Color Bars are generally used to check luminance, hue, and saturation levels.

Split Field Color Bars (Full Field Only). This signal consists of the luminance portion of the Color Bar signal on each active line of each field, and the chrominance portion of the Color Bar signal only on those lines which have been programmed for "WINDOW" (lines 66 through 218).

MODULATED PEDESTAL—This signal consists of three chrominance levels (20, 40, and 80 IRE) superimposed on a 50 IRE level followed by a 50 IRE level pedestal with no modulation. Phase of the chrominance is 90° from burst. This signal is generally used to measure Liminance Cross Modulation.

COMPOSITE—This signal is composed of the LINEARITY 5 Step staircase and SIN^2 PULSE AND BAR signals described above. Only the horizontal timing has been changed to incorporate both signals within the time of one line.

VIRS—The proposed VIRS can be generated by the 149, and it may be inserted on line 20 of either or both fields as programmed. Standard operational practices regarding VIRS have not been worked out. Therefore, the 149 has been designed to be programmable for a number of possible operating modes. Indicator lamps indicate the presence of an incoming VIRS, whether the incoming VIRS is being deleted and whether a local VIRS is being inserted.

NOTE

VIRS will not be inserted on monochrome video.

Vertical Interval Insertion/Deletion

When the digital programmer is Gen-Locked to a program signal, it may delete and re-insert local VITS as determined by the programming.

As the VITS Deleter/Inserter function involves active circuit elements in the programming within the 149, fail-safe means are provided in the event of a malfunction within the instrument such as loss of sync, power, etc.

A PREVIEW function allows the observation of exactly what lines will be deleted and exactly what signals and levels will be inserted on the program line signal before they are inserted on the program signal itself.

Changes in the programming of the several VIT signals are readily done by removing or moving coded jumpers within the 149. Any signal may be eliminated or moved.

[2] **A. Kastelein, "A NEW SINE SQUARED PULSE AND BAR SHAPING NETWORK", IEEE Transactions of Broadcasting. Volume BC-16, Number 4, Dec. 1970 (pp 84-89).**

FIRST TIME OPERATION

General

The following is primarily intended to familarize operating personnel with the operation of the 149. It consists of a step-by-step procedure which, makes use of each front- and rear-panel control and connector. This procedure will, in most cases, simulate the actual in-service operation of the 149.

The procedure makes use of a waveform monitor to observe field and line rate displays and a vectorscope to observe phase characteristics. An external video source is needed to provide program material (composite video) and an external VIT. The following equipment is used: TEKTRONIX Type 140 NTSC Test Signal Generator, used as an external video and VIT source; TEKTRONIX Type 529 Waveform Monitor, used to observe field and line rate displays; TEKTRONIX 520A NTSC Vectorscope, used to observe phase characteristics. Proper operation of each unit is assumed; refer to the individual operating instructions for each.

The procedure requires the use of seven (7), 75 Ω BNC coaxial cables (TEKTRONIX Part No. 012-0074-00), four (4) 75 Ω end-line terminations (TEKTRONIX Part No. 011-0102-00), and one (1) 75 Ω feed-thru termination (TEKTRONIX Part No. 011-0103-02, supplied with 149). A small blade screwdriver (XceLite R3323 or equivalent) is also required.

Unless stated otherwise, all 149 front- and rear-panel controls and connectors referred to will be in upper-cased letters (e.g., LINEARITY SUBCARRIER) and all controls and connectors of the associated equipment will be initial upper-case letters only (e.g., waveform monitor A Input).

The procedure is arranged in a sequence that depends upon previous control settings and connections, and should be performed in sequence. There are, however, certain places where all equipment is disconnected, allowing an operator to start the procedure at this point if desired.

The following procedure uses the equipment listed. If substitute equipment is used, control settings and/or connections may need to be altered.

Procedure

1. Remove the REMOTE plug, P9014, from the rear-panel REMOTE connector J9014. (See INSTALLATION; Local-Remote Connector, in this section for details.)

2. Set the 149 front-panel controls and rear-panel control as follows:

PROGRAM CONTROL

UNITY GAIN/VAR	UNITY GAIN
PROGRAM/ PREVIEW/ AUXILIARY	PROGRAM
LOCAL/REMOTE	LOCAL

COLOR TEST SIGNAL

Mode	COLOR BARS
Type	FULL FIELD

MULTIBURST 90 IRE

LINEARITY

SUBCARRIER	ON
Mode	5 STEP

FULL FIELD SIG

Mode	LINEARITY
APL	BOUNCE 10-90
VARIABLE	0
POWER	OFF
SYNC SOURCE	Up (Program Line In)

3. Check for correct positioning of the 149 rear-panel Range and Voltage Selectors. (See INSTALLATION: Operating Voltage, in this section for details.) These must be in agreement for the power source to be used. Connect the 149 to the power source via the three-conductor power cord supplied with the 149.

4. Set the POWER switch ON. Note that the green power-on indicator lamp is lit; note that the red NON-SYNCHRONOUS MODE-NO VITS lamp is lit, indicating lack of Gen-Lock.

NOTE

Without Gen-Lock, the 149 will not delete or insert VITS.

5. From the 149 FULL FIELD SIG OUT connector, connect a 75 Ω cable to the waveform monitor A Input connector. Terminate the loop-thru A Input with a 75 Ω end-line termination.

6. Observe the waveform monitor at a 2 Line, then 2 Field Display rate. Note that sync and burst are the only signals being generated.

NOTE

Black Burst is the only signal available at FULL FIELD OUTPUTS with REMOTE PLUG removed.

7. Connect the REMOTE plug, P9014, to the rear-panel REMOTE connector J9014.

NOTE

In steps 8 through 20, 149 operation without Gen-Lock will be demonstrated.

8. Observing the waveform monitor, note that Full Field signals are being generated by the 149. Observe the display at a 2 Line display rate. The display should be the 5 Step LINEARITY test signal, similar to that shown in Fig. 1-2 of this manual.

9. Change the 149 LINEARITY controls. The display will be either the 5 Step, 10 Step or Ramp LINEARITY signal with or without modulation as determined by the setting of the SUBCARRIER switch. Return the LINEARITY switches to produce the 5 Step, with modulation, LINEARITY signal.

10. Set the FULL FIELD SIG mode switch to FLAT FIELD. Observing the waveform monitor display for several seconds, notice the display consists of sync, burst, and a squarewave. The squarewave should automatically bounce between 10 and 90 IRE. Using a small screwdriver, rotate the front-panel RATE control fully clockwise. Note that the time now required for the squarewave to bounce between 10 and 90 IRE is slow (approximately 10 seconds). Turn the RATE control fully clockwise. The rate of bounce should have increased (approximately 1 second). Set the RATE control as desired.

11. Set the APL switch to VARIABLE. The display will consist of burst and sync only. Observing the display, rotate the VARIABLE switch to 10, then 20. Notice that the squarewave increases in amplitude as the VARIABLE is increased. This control allows the operator to select any APL level desired in 10 IRE increments between 0 and 100 IRE. Notice the (50) position of this switch between 0 and 100. As a convenience to the operator, this position allows standard 10-50-90 APL measurements to be made without completely rotating the switch 360°. Observe the display at a 2 Field display rate. The FLAT FIELD signal should occupy all active video lines. Return the waveform monitor for a 2 Line display rate; set the 149 VARIABLE switch to 50 IRE.

12. Set the 149 FULL FIELD SIG mode switch to FIELD SQ WAVE. Notice that the display is similar to the FLAT FIELD signal, except the squarewave is at 100 IRE at all times. Observe the display at a 2 Field display rate. Notice that the squarewave does not occupy all active video lines. Only lines 57 through 227 of each field are used. Return the montior for a 2 Line display.

13. Set the 149 FULL FIELD SIG mode switch to WINDOW. This signal will be similar to that shown in Fig. 1-2 of this manual. It consists of a modulated 12.5T pulse, a 2T pulse, and a 2T Bar. Observe the display at a 2 Field display rate. Notice the 2T and modulated 12.5T pulses occur each active line of both fields, but the Bar occurs only part of the time. The Bar portion of this signal occupies lines 66 through 218 of each field. Set the monitor for a 2 Line display.

14. Set the 149 FULL FIELD SIG mode switch to SIN^2 PULSE AND BAR. This signal should be similar to the WINDOW signal observed in step 13. Observe the display at a 2 Field display rate. Notice that the Bar occupies all active video lines. This is the only difference between SIN^2 PULSE AND BAR and the WINDOW signal. Return the monitor for a 2 Line display.

15. Set the 149 FULL FIELD SIG mode switch to COMPOSITE. The display should be similar to that shown in Fig. 1-2 of this manual. It consists of the 5 Step Staircase (LINEARITY) and the SIN^2 PULSE AND BAR signal. Only the line timing has been changed on these signals. Change the LINEARITY controls. Notice the 5 Step Staircase cannot be changed, but the modulation on the steps corresponds to the setting of the SUBCARRIER switch. Return the LINEARITY switches to 5 STEPS and SUBCARRIER ON.

16. Set the 149 FULL FIELD SIG mode switch to MULTIBURST. This signal should be similar to that shown in Fig. 1-2 of this manual. The signal occupies all active video lines of both fields. Set the MULTIBURST AMPLITUDE switch to 60 IRE. Notice the reduced peak to peak amplitude of each burst packet and the level about which the burst packets are centered. The white level should remain at 100 IRE. Return the MULTIBURST AMPLITUDE switch to 90 IRE.

17. Set the 149 FULL FIELD SIG mode switch to COLOR TEST SIGNAL. Notice the display consists of only the color bar luminance. Change the 149 FULL FIELD/

SPLIT FIELD switch. The display should consist of only color bar luminance. Set the COLOR TEST SIGNAL mode switch to MODULATED PEDESTAL, then 50 IRE. Notice the display consists of a 50 IRE pedestal without chrominance.

NOTE

Without Gen-Lock, no chrominance is available on the COLOR TEST SIGNAL.

18. Set the 149 FULL FIELD SIG mode switch to any position and observe the vertical interval of the display at a 2 Field display rate. There should be no VITS, as the 149 must be Gen-Locked to provide insertion.

19. Disconnect the 75 Ω cable from the OUT connector and connect it to the rear-panel COMPOSITE SYNC connector. There should be no display, as the 149 must be Gen-Locked to provide composite sync.

20. Disconnect the 75 Ω cable from the COMPOSITE SYNC connector and connect it to the CW SUBCARRIER connector. There should be no display, as the 149 must be Gen-Locked to provide CW subcarrier. (See Local/Remote Connector for exception.)

21. Disconnect all connections.

NOTE

In the steps to follow this procedure will, where possible, simulate the actual in-service operation of the 149.

22. Using 75 Ω cables and 75 Ω end-line terminations make the following connections:

a. 149 PROGRAM LINE OUT to waveform monitor A Input; waveform monitor A Input loop-thru to Vectorscope CH A J1 connector; terminate Vectorscope CH A J2 connector into 75 Ω.

b. 149 FULL FIELD TEST SIGNAL to waveform monitor B Input; waveform monitor B Input loop-thru to Vectorscope CH B J50 connector; terminate Vectorscope CH B J51 connector into 75 Ω.

c. Type 140, (external video source) Subcarrier to Vectorscope Ext CW ϕ Ref J310 connector; terminate Vectorscope Ext CW ϕ Ref J311 into 75 Ω.

d. Type 140 (external video source) Comp Sync to waveform monitor Ext Neg Sync Input; waveform monitor Ext Neg Sync Input Loop-thru to Vectorscope Ext Sync J120 connector; terminate Vectorscope Ext Sync J121 connector into 75 Ω.

e. Type 140 (external video source) Comp Video to 149 PROGRAM LINE IN connector. The external video source should be set to provide full field color bars and a color bar VIT on line 20 of both fields.

23. Set the 149 controls and switches as given in step 2, except set the POWER switch ON and the PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PREVIEW. Set the Vectorscope to view the CH A Input (PROGRAM LINE OUT) in a vector mode using external sync and ϕ Reference. Set the waveform monitor to view the B Input (FULL FIELD TEST SIGNAL) at a 2 Line display rate, using external sync.

24. Observe the 149 front-panel. The NONSYNCHRONOUS MODE-NO VITS lamp should be extinguished. This indicates the 149 has been Gen-Locked with the external video, and is capable of deleting and inserting internally generated VITS, and displaying the COLOR TEST SIGNAL.

NOTE

If this lamp is lit, check the 149 rear-panel SYNC SOURCE switch position. It must be in the upper position (this permits synchronization via the 149 PROGRAM LINE IN).

25. Set the 149 FULL FIELD SIG mode switch to COLOR TEST SIGNAL. This signal should be similar to that shown in Fig. 1-2 of this manual. The color bars are 75% amplitude, 100% saturated, with 7.5% setup. The signal occupies all active video lines of both fields. Set the 149 COLOR TEST SIGNAL Type switch to SPLIT FIELD. Observe the display at a 2 Field display rate. Notice that the color bars do not occupy all active video lines. Only lines which are programmed for WINDOW (lines 66-218 of each field) contain both luminance and chrominance. All other lines contain luminance only. Set the monitor for a 2 Line display.

26. Set the 149 COLOR TEST SIGNAL mode switch to MODULATED PEDESTAL. This signal should be similar to that shown in Fig. 1-2 of this manual. The signal consists of a 50 IRE pedestal, on which subcarrier is superimposed in three different levels (20, 40, and 80 IRE) followed by an unmodulated pedestal. This signal occupies all active video lines. Set the COLOR TEST SIGNAL switch to a 50 IRE PEDESTAL. The signal should be similar to the MOD PEDESTAL without modulation.

27. Disconnect the FULL FIELD TEST SIGNAL OUT and connect it to the PREVIEW MONITOR OUT.

28. Notice that the 149 front-panel PREVIEW lamp is lit to indicate status (lamp extinguished indicates relay not energized). In this mode of operation, program video to the PROGRAM LINE IN is being passed to the PROGRAM LINE OUT without interruption as indicated by the vector scope display. Observe the waveform monitor A Input at a field .125 H/Cm display rate. The external color bar VIT should be on line 20 of field one.

29. Observe the waveform monitor B Input (PREVIEW MONITOR). VIRS should be present on line 20 of field one. This signal is similar to that shown in Fig. 1-2 of this manual. Also, note that the 149 front-panel VIRS INCOMING lamp is extinguished and (2) the VIRS INSERT and VIRS DELETE lamps are lit. This indicates (1) the external video source does not contain a VIRS, and (2) if the external video source contains a VIT signal on the line programmed for VIRS, it will be deleted and replaced by the internally generated VIR.

NOTE

The signal appearing at the PREVIEW MONITOR OUTPUT allows operating personnel to observe the actual signal after insertion without actually going to an 'on the air' mode of operation.

30. Using Table 2-2, check that all VIT signals, as factory programmed, are being inserted on the proper line and field. Continue to observe the B Input at a Field .125 H/Cm display rate. (See Operating Changes for selection of other VITS.)

TABLE 2-2

149 Factory Vits Programming

Line	Field	Signal
17	1	MULTIBURST
17	2	COLOR TEST SIGNAL
18	1 & 2	COMPOSITE
19	1 & 2	VIRS
20	1 & 2	OPEN
21	1	Full Line Deletion
21	2	1/2 Line Deletion

31. Set the 149 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM. Observing the waveform monitor A Input (PROGRAM LINE OUT), notice that the internally generated VIT signals have been applied to the 'on the air' signal. Note that the 149 front-panel PROGRAM CONTROL PROGRAM lamp is lit to indicate status.

32. Set the waveform monitor to view line 20 of field 1. Observing the display, set the 149 POWER switch to OFF. Notice the color bar VIT has returned. This indicates external video has bypassed the 149, and demostrates the fail-safe characteristic of the instrument should loss of power, sync, etc., occur during an 'on the air' (PROGRAM) situation. Return the POWER switch to ON.

33. Set the external video source to provide a color bar VIT on line 18 of both fields. Set the waveform monitor to view line 18 of field 1. As factory programmed, the 149 inhibits this VIT as indicated by the waveform monitor display. Set the external video source to provide the VIT on line 17 of both fields. Set the waveform monitor to view line 17 of field 1. The external VIT should be observed. (See Operating Changes in this section for further details.)

34. Connect an external color bar VIT to the rear-panel EXT VITS IN connector via a 75 Ω cable. (If using a Type 140, use the unused Comp Video Output for obtaining this signal.) Notice that the external VIT is not being displayed. As factory programmed, no external VIT can be used. (See Operating Changes in this section for obtaining external VITS.)

NOTE

The following step (No. 35) demonstrates the effect of applying an external VIT (to the 149 EXT VITS IN) on the same line and field as the internally programmed VIT. The external VITS should ONLY be on that line and field which has been programmed for external VITS.

35. Set the external video source to provide the external color bar VIT on line 18 of field one. Set the waveform monitor to view line 18 of field one. The display should now be distorted. Disconnect the 75 Ω cable to the 149 rear-panel EXT VITS IN. The display should now be the MULTIBURST VIT without distortion. Reconnect the 75 Ω cable to the EXT VITS IN and set the external video source to provide the external VIT on line 17 of field one.

36. Observing the waveform monitor A Input at a 2 Field Display rate and the Vectorscope CH A Input (both are PROGRAM LINE OUTPUTS), set the 149 PROGRAM CONTROL UNITY GAIN/VAR switch to VAR and rotate the LEVEL control. The amplitude of the external video can now be varied with the LEVEL control. Observe the waveform monitor display of the vertical interval with X25 magnification. Rotation of the 149 LEVEL control should not affect internally-generated VITS. Turn off the waveform monitor magnification and adjust the LEVEL control for a signal amplitude of 140 IRE peak to peak. (The LEVEL control allows the operator to match incoming program material to the internally generated signals.) Return the PROGRAM CONTROL to UNITY GAIN.

37. Observing the Vectorscope display, use a small screwdriver and rotate the 149 PROGRAM CONTROL INSERT SUBCARRIER PHASE control. There should be a vector representing internally generated subcarrier which is controlled by rotation of this control. Superimpose this vector with the vector representing external subcarrier. The INSERT SUBCARRIER PHASE control enables the operator to match the phase of the internally generated subcarrier to the phase of the external subcarrier.

38. Set the 149 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to AUXILIARY, and view the waveform monitor B Input (PREVIEW MONITOR) at a 2 Line Display rate. Sync and burst will be double amplitude. As explained under Controls and Connectors, when in AUXILIARY mode of operation with an external VIT to the EXT VITS IN connector, there must be no sync or burst added with the external VIT. Disconnect the 75 Ω cable from the EXT VITS IN connector. Sync and burst should now be normal amplitude.

39. Observing the waveform monitor display, rotate the 149 PROGRAM CONTROL AUXILIARY PEDESTAL control. The peak amplitude of the displayed squarewave (pedestal) can now be varied between 0 and 100 IRE. Observing the waveform monitor A Input (PROGRAM LINE OUT), notice that the external color bars are displayed and rotation of the AUXILIARY PEDESTAL control has no effect. The Auxiliary signal will be only applied to the PREVIEW MONITOR OUTPUT, with the PROGRAM LINE IN bypassed through the relay to the PROGRAM LINE OUTPUT. Set the waveform monitor to view the B Input (PREVIEW MONITOR).

NOTE

In AUXILIARY Mode, PROGRAM MONITOR will have no output; in all other modes, same as PROGRAM LINE OUT.

40. Apply a color bar signal via a 75 Ω cable to the 149 AUX IN connector. (If using the Type 140, use the same signal applied to the EXT VITS IN from the Comp Video Output.) The externally applied color bar has been added on the pedestal level of the auxiliary signal. Rotate the AUXILIARY PEDESTAL control. The pedestal on which the external color bar is riding can again be changed between 0 to 100 IRE with rotation of this control. This input, although demonstrated using a color bar, can be driven by any signal desired for a specific application such as a sweep generator, etc.

41. Set the 149 PROGRAM CONTROL REMOTE/LOCAL switch to REMOTE. Note that the 149 PROGRAM CONTROL PREVIEW lamp is lit to indicate status. Observe the waveform monitor at first a 2 Line Display rate, then a 2 Field display rate. The display should contain only the external video signal. Switch the PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY to any position. There should be no change to the displayed output.

NOTE

With the PROGRAM CONTROL REMOTE/LOCAL switch set to REMOTE, control is via the rear-panel REMOTE connector. As factory connected, the 149 operates in PREVIEW mode.

42. Set the 150 switches and controls as given in step 2 of this procedure, except set the POWER switch ON, PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM, and the rear-panel SYNC switch down. Observing the waveform monitor A Input (PROGRAM LINE OUT) at a 2 Field Display rate, notice that only the external video is being passed by the 149. Also, note the front-panel NONSYNCHRONOUS MODE—NO VITS lamp is lit, indicating lack of Gen-Lock. Under this condition, the 149 will not insert or delete.

43. Disconnect the external color bar signal from the 149 AUX IN connector and reconnect it to the rear-panel BLACK BURST INPUT connector; terminate the other BLACK BURST INPUT Loop-thru connector into 75 Ω. Set the external sync source to obtain 'Black Burst'. (If using the Type 140, set the Video switch to Off.) The 149 NONSYNCHRONOUS MODE-NO VITS lamp should be extinguished, and the waveform monitor should be displaying the inserted VITS.

44. Set the waveform monitor to view line 20 of field one of the A Input at a Field .125 H/Cm Display rate. The VIRS will be displayed. Using a small screwdriver, rotate the 149 INSERT DELAY control. The position on the line of the VIR signal can be changes, thus allowing the operator to control time positioning of internally generated VITS with respect to the incoming signal.

45. Disconnect all test equipment and set the 149 controls and switches as given in step 2 of this procedure, except set the POWER switch ON and the PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM, and the rear-panel SYNC switch down.

NOTE

The following demonstrates if the 149 will accept and display an external VIR. It is not intended that the operator use the instrument in the manner described.

46. Connect an external Black Burst signal to the 149 rear-panel BLACK BURST IN connector; terminate the other BLACK BURST IN connector into 75 Ω. Connect a 75 Ω cable between the rear-panel FULL FIELD TEST SIGNAL OUTPUT connector and the rear-panel PROGRAM LINE IN connector.

47. Notice the 149 front-panel VIRS INCOMING, VIRS DELETE, and VIRS INSERT lamps; each should be flickering. This merely indicates that the VIRS INCOMING circuits are working properly. If an external VIR were used, these lights would stay on to indicate VIR status. (Refer to Operating Changes in this section for additional details.)

48. This completes the first time operation.

OPERATING CHANGES

General Information

The 149 is factory connected to produce the output signals which are most frequently used by the television industry. However, the 149 is versatile, in that many internal changes can be made which alter these signals to meet certain applications. For example, the COMPOSITE signal (both Full Field and VIT) as shipped from the factory generates and displays the 5 Step Staircase as a portion of the total signal. This may be internally changed to provide the Ramp signal (in place of the staircase) on the COMPOSITE signal.

The following provides the information necessary to change or modify the 149 where possible.

NOTE

Some of the changes or modifications that follow require internal adjustment to comply with industry standards. We recommend that only qualified personnel, thorougly familiar with calibration procedures and video signals, make these changes.

VITS Line and Field Selection

VITS may be selected to appear on lines 10 through 21 of field one, field two, or both fields. Line and Field Selection is accomplished by selecting various internal quick-change pin connectors on the VIT and FF circuit board. An access door is provided so that VITS selection can be made without removing the top cover from the instrument.

Referring to Fig. 2-5, notice that a rectangular matrix is used to select the line and field for each VIT signal. Two jumper plugs must be used to select the VIT; one for field selection, the other for line selection. (Exception: VIRS has only field selection.) To prevent or disable a particular VIT, except VIRS, move the line jumper plug to the OFF position.

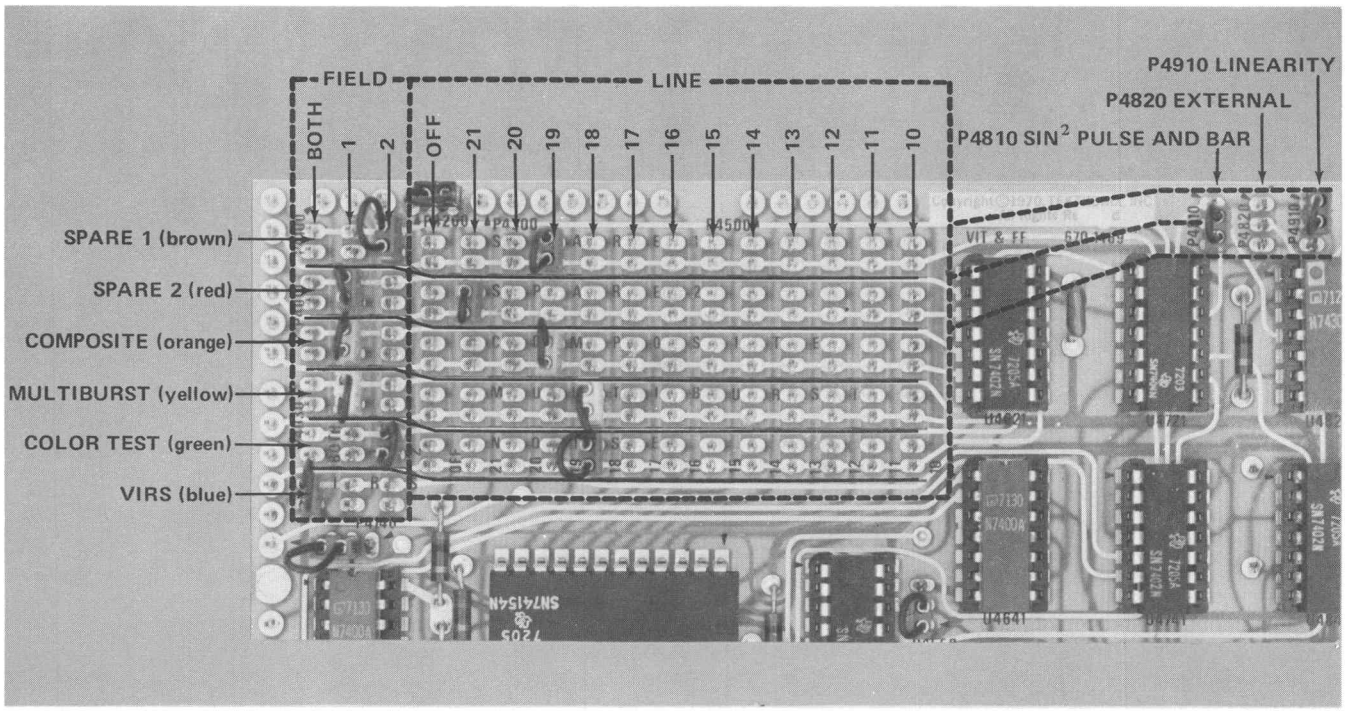


Fig. 2-5. VIT and FF circuit board location of the VITS Line and Field selector plugs.

NOTE

To prevent or disable VIRS, pin 21 of the REMOTE PLUG (P9014) must be disconnected. See Fig. 2-2 of this section.

Each jumper plug has been assigned a particular color which are brown, red, orange, yellow, green, and blue respectively. This coding simplifies identifying the various VIT signals, and any same-color jumper plug (except black) on the VIT and FF circuit board will affect only that particular signal.

The following information details each VIT signal available.

VIRS: Internally set to appear on line 20. Operating personnel may select field one, field two, or both fields.

COLOR TEST SIGNAL, MULTIBURST, COMPOSITE: Operating personnel may select any line from 10 through 21 of field one, field two, or both fields.

SPARE 2: Operating personnel may select any line 10 through 21 of field one, field two, or both fields for one of the following:

SIN² PULSE AND BAR: Pins two and three of P4810 (see Fig. 2-5) must be connected.

LINEARITY: Pins two and three of P4910 must be connected.

EXTERNAL: Pins two and three of P4820 must be connected.

SPARE 1: Operating personnel may select any line 10 through 21 of field one, field two, or both fields for the SIN² PULSE AND BAR, LINEARITY, or EXTERNAL VITS. Selection is accomplished as for SPARE 2, except connections must be made between pins one and two of P4810, P4820, or P4910.

NOTE

To delete a VIT, program for EXTERNAL and do not put an EXTERNAL VIT into the EXT VITS IN connector.

VIT Cover

As a convenience to the operator, a VIT program cover is supplied with the 149 with factory connected VITS written in; see Fig. 2-4 of this manual. This cover can be removed and the front-panel will consist of an array of write-in spaces where the internal line and field addresses of the VIT signals may be indicated as programmed by the operator.

Line 21 Deletion/Pass

As factory connected, any incoming signal which occupies line 21 of either field will be deleted as follows: line 21 of field one, all active line time; line 21 of field two, first one-half of active line time. To pass line 21 of either field, change the connector on pins two and three of P4200 (see Fig. 2-6) to pins one and two.

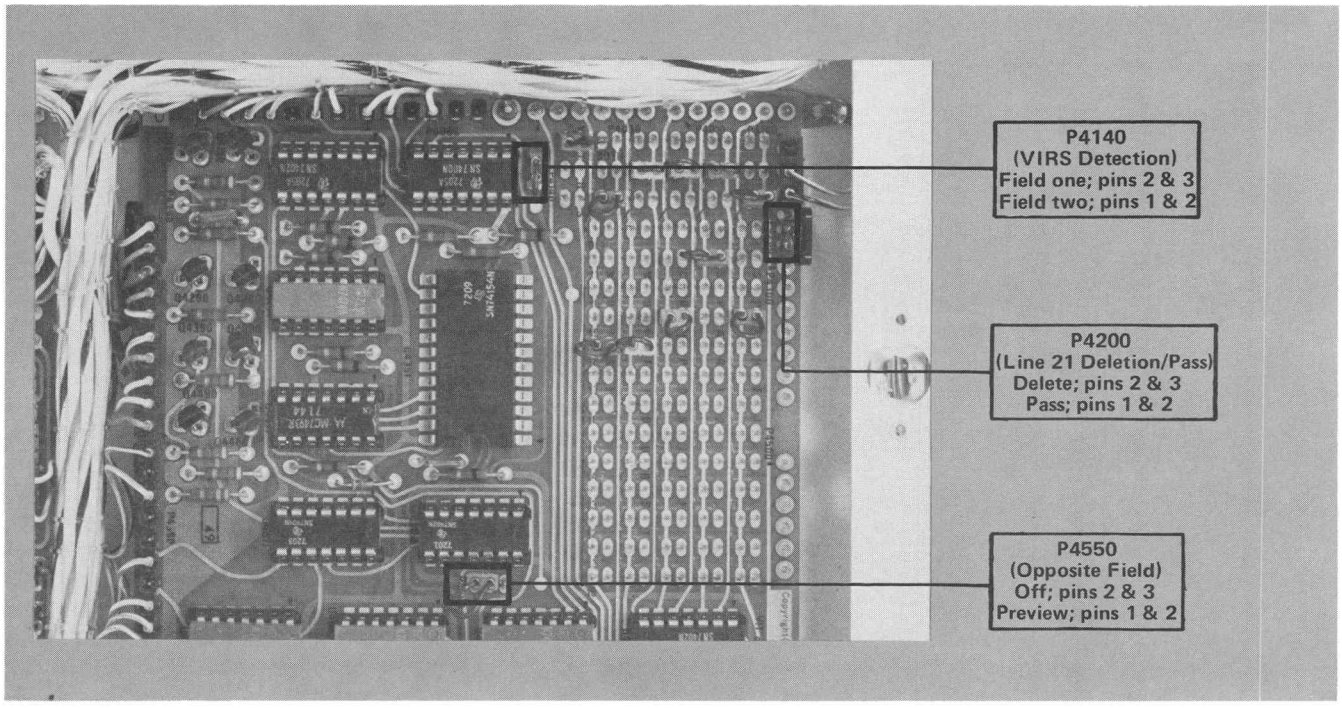


Fig. 2-6. VIT and FF circuit board location of VIRS Detection, Opposite Field Preview, and Line Deletion selector plugs.

Ⓐ

External VIRS Detection and Opposite Field Preview

The following options have been grouped together because of interaction between them. They are also dependent upon the presence or absence of an external VIRS to the PROGRAM LINE IN, and upon the 149 internal field programming for VIRS.

The position of the connector on P4140 (see Fig. 2-6) determines which field of the incoming signal is detected for VIRS. Field one detection is obtained by connecting between pins two and three. Field two detection is obtained by connecting between pins one and two.

The position of the connector on P4550 determines whether internal VIRS will be inserted on the opposite field from external VIRS in the PREVIEW mode of operation. Connecting pins one and two of P4550 allow insertion (Preview); pins two and three connected will not.

Table 2-3 lists the various conditions under which this change is effective.

NOTE

With (1) no external VIRS in or (2) 149 programmed for BOTH fields, the Opposite Field Preview is inoperative.

TABLE 2-3

External VIRS Detection and Opposite Field Preview

VIRS Field Programming		Changes		149 Program Control			
		VIRS Field Detection	Opposite Field Preview	PREVIEW MODE; PREVIEW MONITOR DISPLAY of VIRS		PROGRAM MODE; PROGRAM MONITOR DISPLAY of VIRS	
Int	Incoming	(P4140)	(P4550)	Field One	Field Two	Field One	Field Two
1	1	1	PREVIEW	EXT	INT	EXT	NONE
1	1	1	OFF	EXT	NONE	EXT	NONE
2	2	2	PREVIEW	INT	EXT	NONE	EXT
2	2	2	OFF	NONE	EXT	NONE	EXT
1	BOTH	1	PREVIEW	EXT	INT	EXT	EXT
1	BOTH	1	OFF	EXT	EXT	EXT	EXT
1	BOTH	2	PREVIEW	EXT	INT	EXT	EXT
1	BOTH	2	OFF	EXT	EXT	EXT	EXT
2	BOTH	1	PREVIEW	INT	EXT	EXT	EXT
2	BOTH	1	OFF	EXT	EXT	EXT	EXT
2	BOTH	2	PREVIEW	INT	EXT	EXT	EXT
2	BOTH	2	OFF	EXT	EXT	EXT	EXT

NOTE

With P4550 in OFF (Pins 2 and 3), PREVIEW and PROGRAM are the same.

Horizontal Programming

The 149 is versatile, in that any signal generated may be internally reprogrammed, using quick change connectors, to produce signals which are timed according to specific user applications. Fig. 1-2 (Section 1 of this manual) shows the signals generated by the 149 along with all timing information.

Using the COMPOSITE test signal as an example, notice that the horizontal axis has been plotted in microseconds from 0 to 64 (in NTSC, this is actually 63.56 μs, the difference to be explained later) with 10, 14, 17, etc. listed along the axis. Each of these listed times corresponds to a particular portion of the complete signal, which can be reprogrammed as desired. In other words, the 2T pulse might be reprogrammed to start at 32 μs, or completely eliminated.

Characteristic Instants

All signal programming is controlled by selection of various gate signals derived by the 149 Horizontal Counter. These gate signals are brought to circuit board square pins for easy access, see Fig. 2-7. There are three groups of pin connectors; Instant, +, and 1/2 Instant. The first group, Instant, is arranged to provide 32 columns with nine rows of pins per column row. These columns are numbered, left to right, 3, 4, ...32, 1, and 2. Each number is a Characteristic Instant and is exactly equal to

$$\frac{63.56\ \mu s}{32} = 1.98606\ \mu s,$$

or approximately 2 μs. The Characteristic Instant, therefore, represents the time axis of Fig. 1-2, and is the reason for an apparent H Rate of 64 μs.

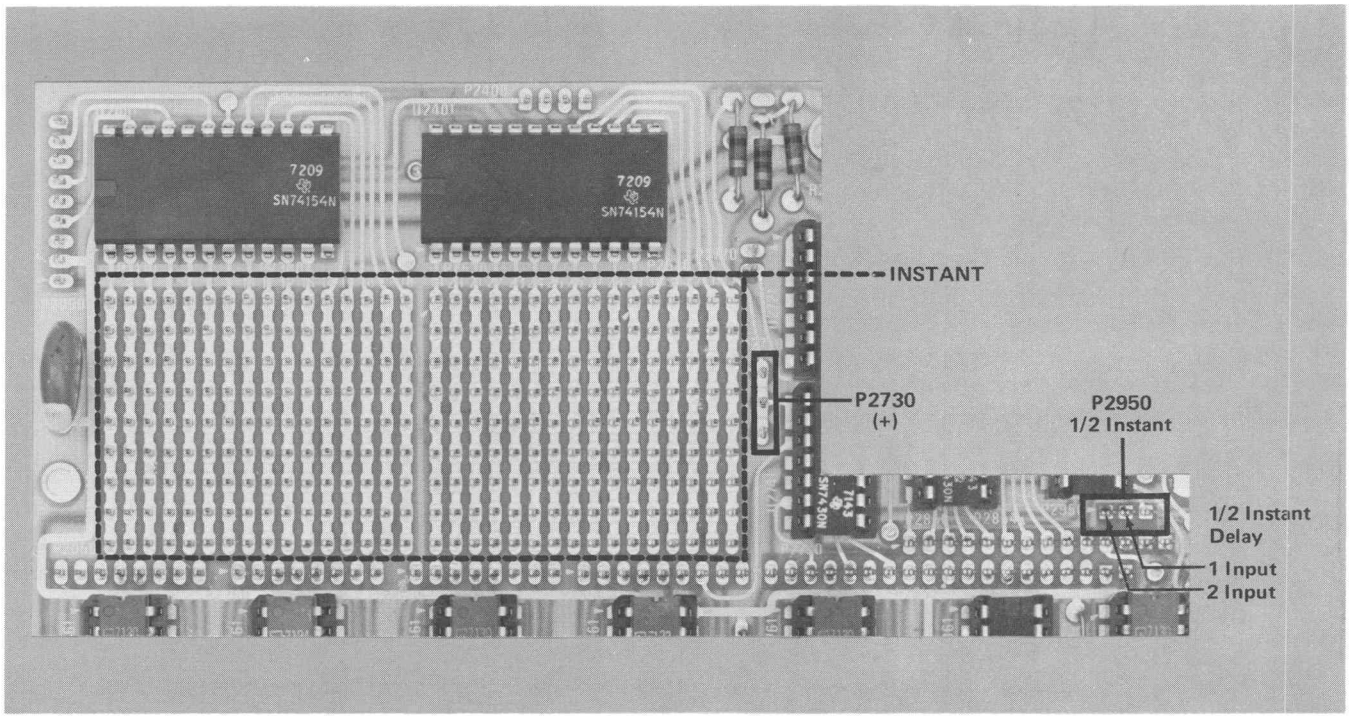


Fig. 2-7. Horizontal timing circuit board location of Characteristic Instants. Use with Table 2-4 and Fig. 1-2.

The second group of pins, + (P2730), contains three pins. This column of pins is used to connect unused inputs. Its use will be explained shortly. The third group of pins, 1/2 Instant (P2950), contains two pins which are internally connected to provide a 1/2 Characteristic Instant (1 μs) timing change. This will also be covered in the example to follow.

Table 2-4 lists the programming as factory connected, and for obvious reasons, all wires and connectors used to program the 149 are color coded. Use of Table 2-4 will be covered in the following example.

NOTE

Reprogramming of some signals may require internal calibration. We recommend that only qualified personnel, thoroughly familiar with the different signal characteristics and calibration procedures, perform these programming changes.

The following example uses the staircase portion of the COMPOSITE signal and involves all three groups of Instants. It is assumed that the staircase portion of this signal has (1) been completely disabled (e.g., all programming wires associated with this signal are disconnected) and (2) the staircase signal will be programmed to provide the same timing as that shown in Fig. 1-2 of this manual.

Proceed as follows:

a. Referring to Table 2-4 scan the Signal, Affected Portion, and Function columns for all possible connections for the staircase portion of the COMPOSITE signal. These are (1) Modulation Set; (2) Modulation Reset; (3) Step Enable Set; (4) Step Enable Reset; (5) 1st Level Set; (6) 2 and 4th Level Set; (7) 3rd Level Set; and (8) 5th Level Set.

b. Directly opposite the Signal, Area Affected, and Function columns for each possible connection found in part a, note the Wire and Connector Color Code column and the μs and Instant Timing column. This gives the color code of the wire, color code of the connector connected to the wire, time for a particular signal segment, and the instant which corresponds to the time of the signal segment. For connection (3), Steps Enable Set, notice for the wire code a 9-4, for the connector a 0, for the μs an 8, and for Instant a 4. This indicates that a white wire with a yellow strip (9-4) and black connector (0) is the only programming wire for the Steps Enable Set circuitry within the instrument. This 9-4/0 combination, when connected to Instant 4 (8 μs) on the Horizontal Timing circuit board will enable the steps portion of the COMPOSITE signal to be generated.

Using the above connection as a guide, connect the signal segment wires for (1), (4), (5), (7), and (8).

TABLE 2-4

Factory Horizontal Programming

Signal	Affected Portion	Function	Color Code Wires	Color Code Connector	Timing μ Sec	Timing Instant	Key To Table Instant	Key To Table Wires
All, except VIRS & COMPOSITE	H Blanking	Set	9-5	0	10	5	1	9–1
		Reset	9-34	0	62	31	2	9–2
COLOR TEST	20 IRE Mod	Set	9-5	4	10	5	3	9–3
COMPOSITE	Setup	Set	9-07	0	32	16	4	9–4
		Reset	9-34	3	62	31	5	9–5
	Modulation	Set	9-5	2	10	5	6	9–6
		Reset	9-36	0	29	14.5	7	9–7
	Step Enable	Set	9-4	0	8	4	8	9–8
		Reset	9-07	1	32	16	9	9–0
	1st Level	Set	9-7	0	14	7	10	9–01
	2nd & 4th Level	Set	9-37	0	17/23	8.5/11.5	11	9–02
	3rd Level	Set	9-01	0	20	10	12	9–03
	5th Level	Set	9-04	0	26	13	13	9–04
	Pulse	Set	9-12	3	36	18	14	9–05
	Modulated Pulse	Set	9-13	0	38	19	15	9–06
		Reset	9-15	0	42	21	16	9–07
	Bar	Set	9-16	0	44	22	17	9–08
		Reset	9-34	1	62	31	18	9–12
LINEARITY	Modulation	Set	9-5	3	10	5	19	9–13
		Reset	9-27	0	58	29	20	9–14
	10 Step 1st Level	Set	9-0	0	18	9	21	9–15
	2nd Level	Set	9-02	0	22	11	22	9–16
	3rd Level	Set	9-04	0	26	13	23	9–17
	4th Level	Set	9-06	0	30	15	24	9–18
	5th Level	Set	9-08	1	34	17	25	9–23
	6th Level	Set	9-13	0	38	19	26	9–24
	7th Level	Set	9-15	0	42	21	27	9–25
	8th Level	Set	9-17	0	46	23	28	9–26
	9th Level	Set	9-23	1	50	25	29	2–27
	10th Level	Set	9-25	2	54	27	30	9–28
	Ramp	Set	9-8	0	16	8	31	9–34
		Reset	9-26	0	56	28	32/0	9–35
MULTIBURST	White Flag	Set	9-5	1	10	5		
		Reset	9-8	2	16	8		
	Center Level	Set	9-8	4	16	8		
		Reset	9-34	2	62	31		
	Burst Width	Set	9-1	0	2	1		
		Reset	9-07	2	32	16		
	0.5 MHz	Set	9-0	1	18	9		
	1.25 MHz	Set	9-05	0	28	14		
		Reset	9-12	1	36	18		
	2.0 MHz	Set	9-12	2	36	18		
		Reset	9-15	1	42	21		
	3.0 MHz	Set	9-15	2	42	21		
		Reset	9-18	2	48	24		
	3.58 MHz	Set	9-18	0	48	24		
		Reset	9-25	0	54	27		
	4.1 MHz	Set	9-25	1	54	27		
		Reset	9-34	4	62	31		
PULSE & BAR (WINDOW)	Mod Pulse	Set	9-6	1	12	6		
		Reset	9-8	1	16	8		
	Pulse	Set	9-01	2	20	10		
	Bar	Set	9-03	0	24	12		
		Reset	9-23	0	50	25		
VIRS	Modulation	Set	9-6	0	12	6		
		Reset	9-08	0	34	17		
	70 IRE Level	Set	9-6	2	12	6		
		Reset	9-12	0	36	18		
	50 IRE Level	Set	9-6	4	12	6		
		Reset	9-18	1	48	24		
	7.5 IRE Level	Set	9-6	3	12	6		
		Reset	9-28	0	60	30		
INHIBIT DELAY	------	---	9-45	0	---	+		
	1 Input 1/2 Instant Delay	---	9-05	1	28	14		
	2 Input 1/2 Instant Delay	---	9-8	3	16	8		
	2 Input 1/2 Instant Delay	---	9-02	1	22	11		

Color Code	
0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White

Example: A wire connected to INSTANT 24 has a color code of 9-18 and is read, BROWN-GRAY on WHITE. If this wire is the only connection to INSTANT 24, it will have a black connector. The second wire to INSTANT 24 will be 9-18/1 and read, BROWN-GRAY on WHITE with BROWN connector.

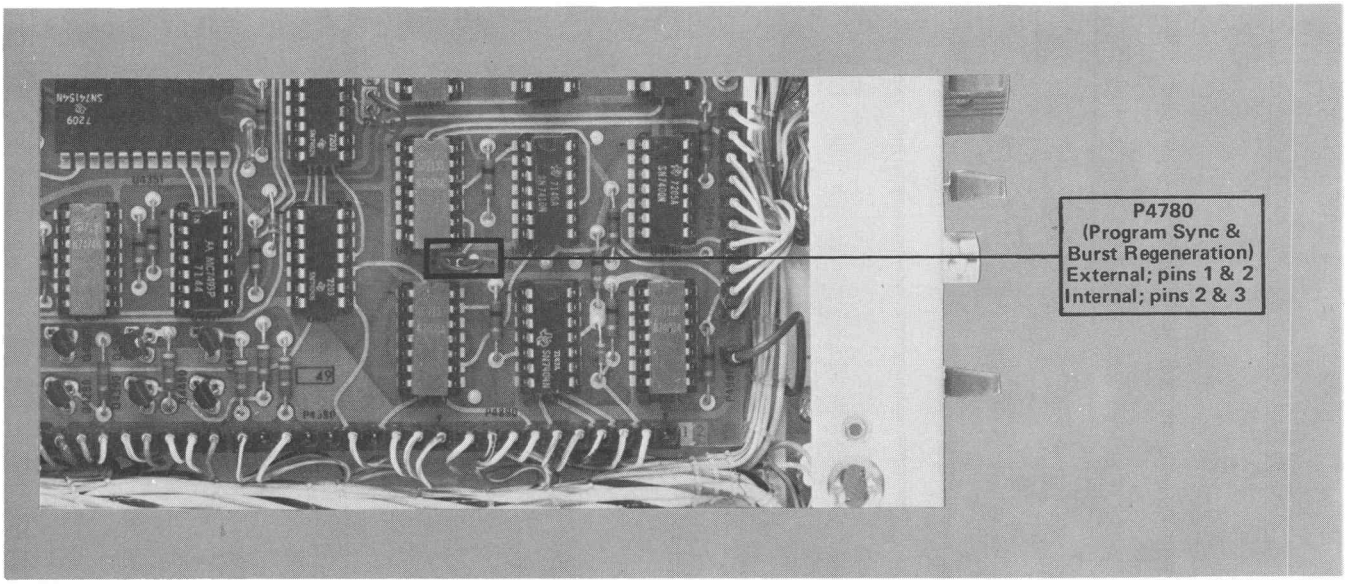


Fig. 2-8. VIT and FF circuit location of program sync and burst regeneration selector plug.

c. For signal segment (2), Modulation Reset, notice the Timing column. A 1/2 Instant (14.5) is being used. This is accomplished by programming to Instant 14, delaying 1 μs, then applying the delayed programming signal to the Steps Modulation Reset circuitry within the 149.

Locate the wire and connector combination of 9-05/1 (used with Instant 14) and connect it to Instant 14 (input to 1 μs delay). Now, locate the 9-36/0 combination and connect it to pin 2 of P2950 (output of 1 μs delay). Connections made will add 1/2 Instant or 1 μs to the count, allowing the Steps Modulation to Reset (stop) at 29 μs.

d. For signal segment (6) notice the Timing column. Two 1/2 Instants (8.5 and 11.5) are given. Locate the 9-8/3 and 9-02/1 combinations and connect them to Instant 14 (2 input to 1 μs delay). Next, locate the 9-37/0 combination and connect it to pin 1 of P2950 (output of 1 μs delay). This will add 1 μs to the second and fourth step starting points, starting them at 17 and 23 μs respectively.

e. Once all the above connections have been made, check that all signal segments appear as given in Fig. 1-2.

Removing 1/2 Instants

In the above procedure, it was shown how to program in a 1/2 Instant. Now, assume the staircase portion of the COMPOSITE signal were to contain no 1/2 Instants. That is, signal segment (2) was to be programmed to reset at Instant 14 and that signal segments of (6) were to be programmed to set at Instant 8 and 11.

To reset at Instant 14 rather than 14.5, disconnect the 9-36/0 combination from pin 2 of P2950 and reconnect it to Instant 14. To start the second step at Instant 8, disconnect the 9-37/0 combination from pin 1 of P2950 and reconnect it to Instant 8. Disconnect the 9-45/0 combination from + (P2730) and connect it to Instant 11.

Deleting Instants

To delete any programming, connect the signal segment programming wire to the + (P2730) Instant. Connecting any wire to the + will disable that particular function. For example, locate the 9-4/0 combination for the Steps Enable Set, connected in part b of the example, and connect it to the + Instant. The staircase portion of the COMPOSITE signal will now be eliminated.

Program Sync and Burst Regeneration

Internally processed sync and burst (Gen-Locked to PROGRAM LINE IN signal) can be substituted for the PROGRAM LINE IN sync and burst before being applied PROGRAM LINE OUTPUT. To use internal sync and burst, change the connector on pins one and two of P4780 to pins two and three. See Fig. 2-8 for location of P4780.

IMPORTANT

Connection between pins one and two of P4780 is normal operating mode. In regeneration mode (pins two and three), all incoming VITS will be removed, including VIRS. If external signal input goes MONO while using internal sync and burst, the 149 automatically switches to the external sync.

CW Subcarrier Lock

If desired, the 149 can be Gen-Locked to a composite sync signal with superimposed, subcarrier (such as RCA CompSync) through the BLACK BURST INPUT. This is accomplished by changing the connector on P5141, see Fig. 2-9, from pins one and two to pins two and three.

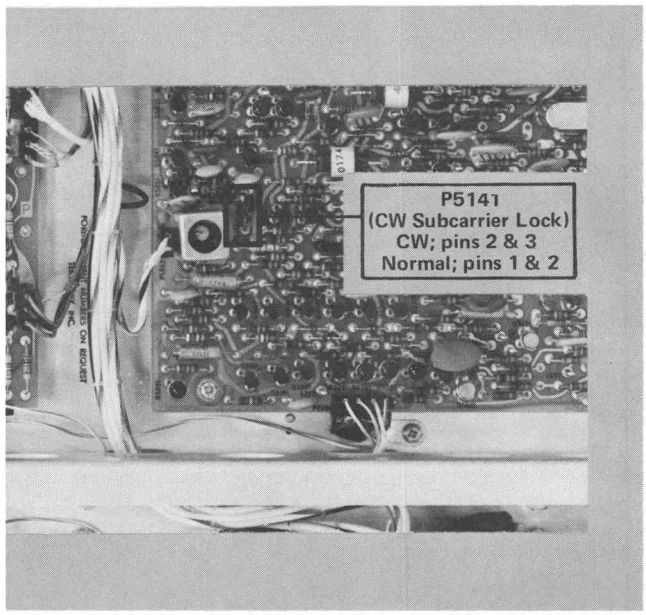


Fig. 2-9. Gen-lock circuit board location of CW Subcarrier Lock selector plug.

LINEARITY Modulation and Staircase Levels

The following options have been grouped, since there is interaction between them, and depending upon needed signal levels could require internal calibration.

As shipped from the factory, the LINEARITY test signal modulation amplitude is 40 IRE peak to peak. To obtain modulation amplitude of 20 IRE peak to peak, change the connector on pins two and three of P3400, see Fig. 2-10, to pins one and two.

To obtain different levels of staircase or ramp, proceed as follows:

5 STEP — Set the 149 LINEARITY switches for 5 STEPS and SUBCARRIER OFF. For a 5 Step amplitude of between 80 and 90 IRE, adjust C3565 (see Fig. 2-10) for the desired amplitude. For a 5 Step amplitude of between 90 and 100 IRE, connect P3470 between pins two and three (see Fig. 2-10) and adjust C3565 for the desired amplitude.

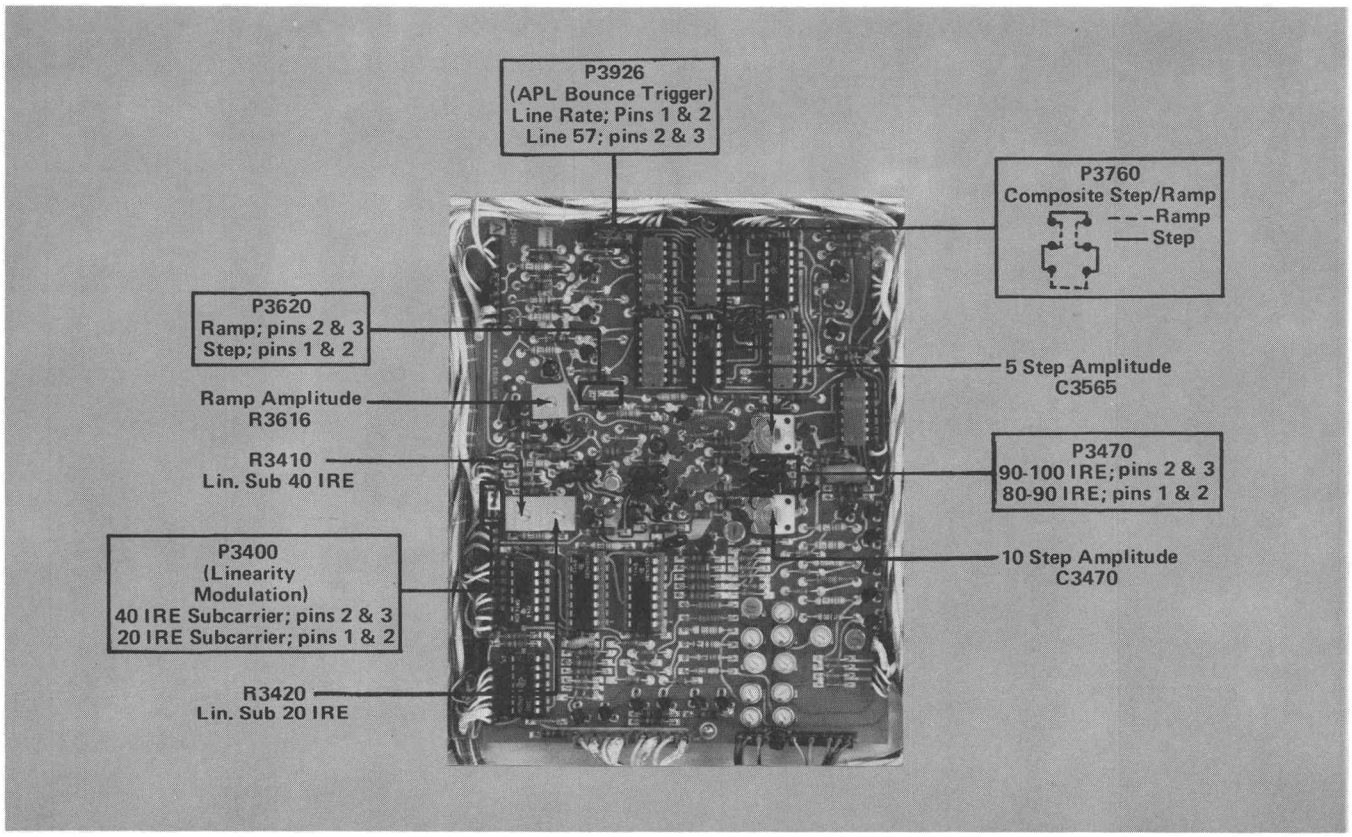


Fig. 2-10. APL, Staircase, and Color Bar circuit board location of selector plugs and adjustments for LINEARITY operating changes.

10 STEP	Set the 149 LINEARITY switches for 10 STEPS and SUBCARRIER OFF. Adjust C3470 for the desired 10 Step amplitude.
RAMP	Set the 149 LINEARITY switches for RAMP and SUBCARRIER OFF. Adjust R3616 for the desired ramp amplitude.

COMPOSITE Test Signal With Ramp

Shipped from the factory, the 5 Step staircase is generated as a portion of the COMPOSITE signal. To replace the steps with ramp, rotate P3760 (see Fig. 2-10) 180°, and connect P3620 (see Fig. 2-10) between pins two and three.

NOTE

Requires horizontal reprogramming and internal adjustment.

Adjustment Procedure

a. Set the 149 LINEARITY SUBCARRIER switch OFF.

b. Using Fig. 2-7 and Table 2-4 as guides, reprogram the RAMP as follows:

Set, Instant 7 (9-8/0); Reset, Instant 14 (9-26/0).

d. Adjust Ramp Amplitude control, R3616, for 80 IRE between blanking and the ramp peak.

APL Bounce Trigger

As factory connected, the FLAT FIELD BOUNCE signal switches on line 57. If desired, the switching can be made to occur at random by changing the connector on pins two and three of P3926, see Fig. 2-10, to pins one and two.

Modulated 12.5T/20T Sine-Squared Pulse

As factory connected, the 149 displays the modulated 12.5T Pulse. This may be changed to display the modulated 20T Pulse by changing the connector on pins two and three of P6050 (see Fig. 2-11) to pins one and two.

NOTE

This reconnection requires internal adjustment.

Adjustment Procedure

1. Observe the SIN^2 PULSE AND BAR FULL FIELD TEST SIGNAL OUTPUT signal.

2. Adjust R8109 (Sin^2 Chroma Gain), see Fig. 2-13 and R7357 (Luminance Gain) for (1) a peak modulation amplitude of 100 IRE and (2) the best flat bottom on the pulse.

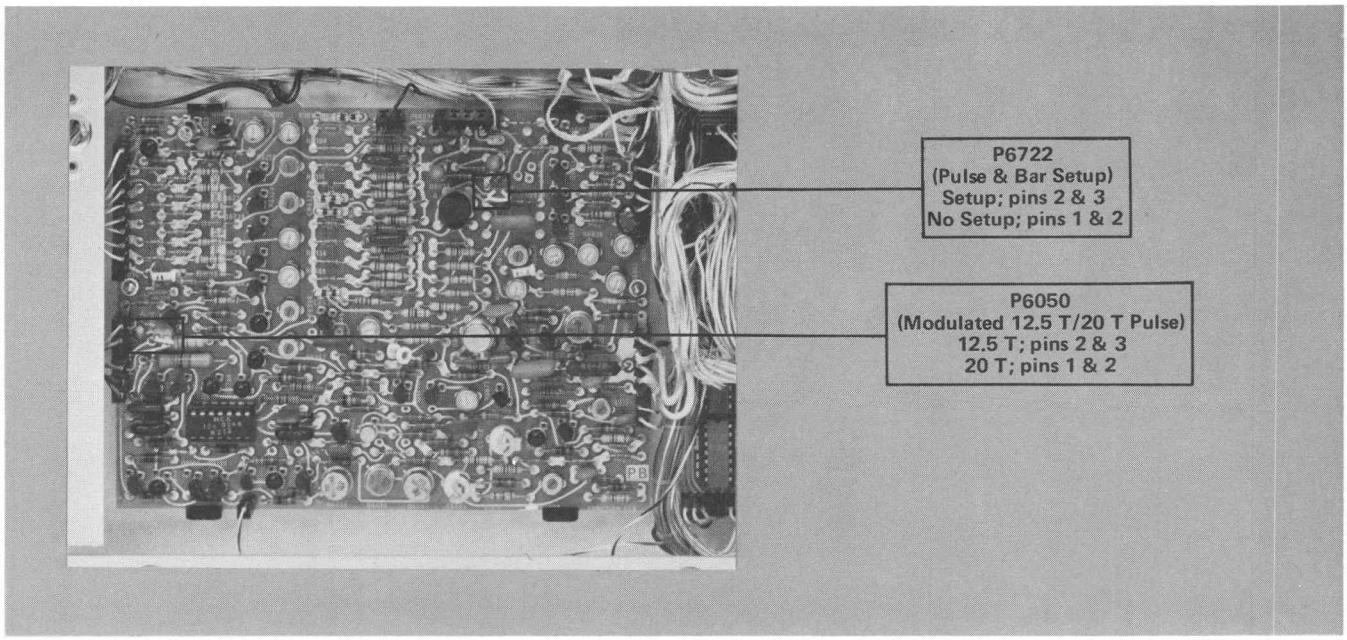


Fig. 2-11. Function Generator circuit board location of selector plugs.

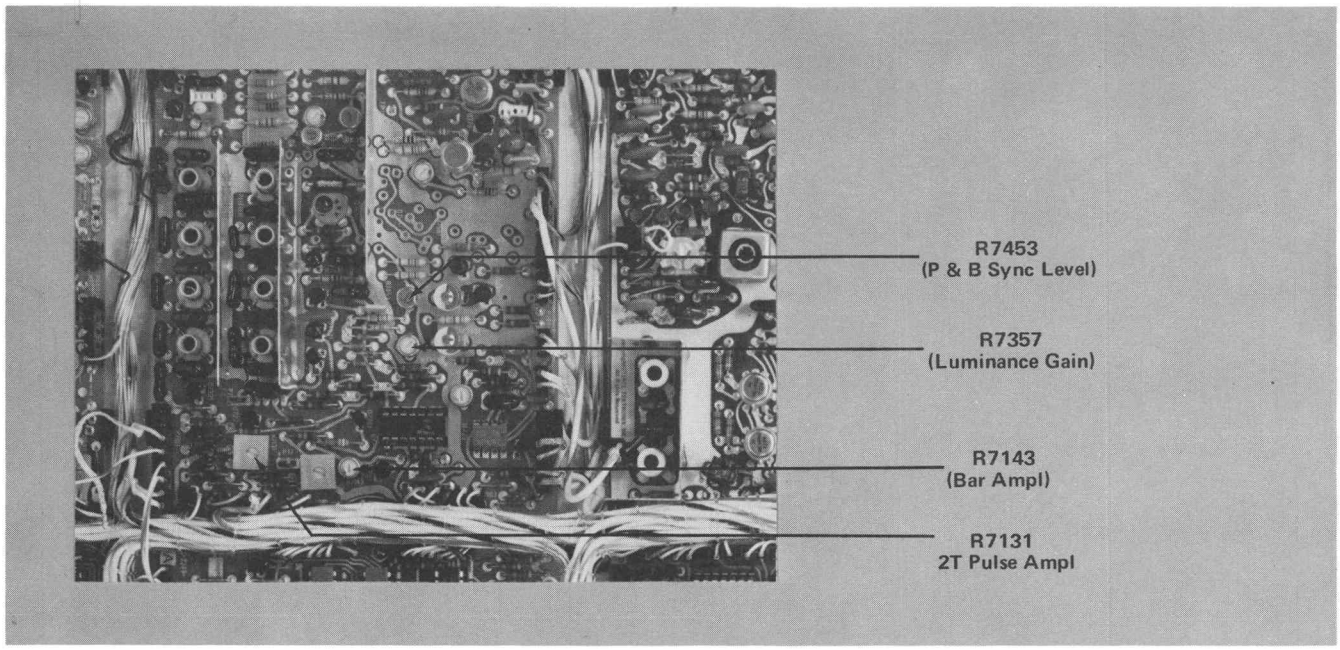


Fig. 2-12. Output Amplifier circuit board location of adjustments.

3. Adjust R7453 (P and B Sync Level), see Fig. 2-12, until the luminance level is aligned with the blanking level.

Sine-Squared Pulse and Bar Setup

As factory connected, setup is not present on this signal. Setup can be obtained by changing the connector on pins one and two of P6722 (see Fig. 2-11) to pins two and three.

NOTE

This reconnection requires internal adjustments.

Adjustment Procedure

1. Observe the SIN^2 PULSE AND BAR FULL FIELD OUTPUT signal.

2. Adjust R7131 (2T Pulse Amplitude), see Fig. 2-12, for a peak pulse amplitude of 100 IRE.

3. Adjust R7143 (Bar Amplitude) for a peak bar amplitude of 100 IRE.

4. Adjust R7357 (Luminance Gain) for equal amounts of chrominance above the 100 IRE level and below the setup level (10 IRE).

5. Adjust R7453 (P and B Sync Level) until the luminance level is aligned with the blanking level.

6. Adjust R8109 (Sin^2 Chroma Gain), see Fig. 2-13, until the peak of chrominance within the modulated pulse is at 100 IRE and the bottom portion of chrominance within the modulated pulse is flat at 10 IRE.

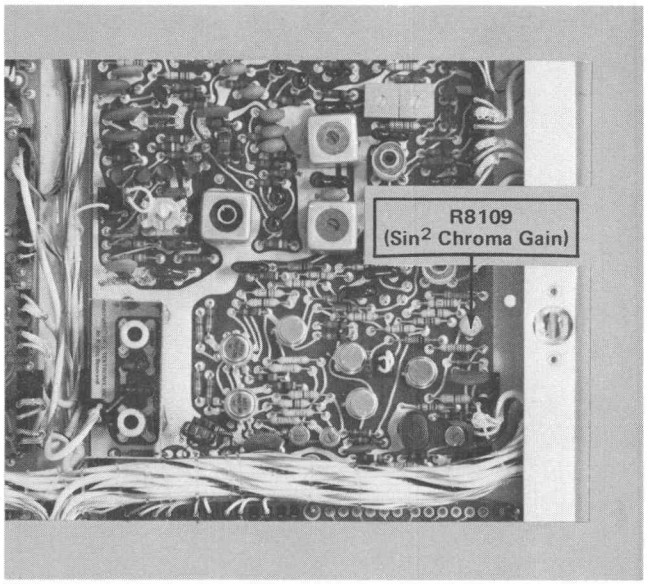


Fig. 2-13. Modulator circuit board location of adjustments.

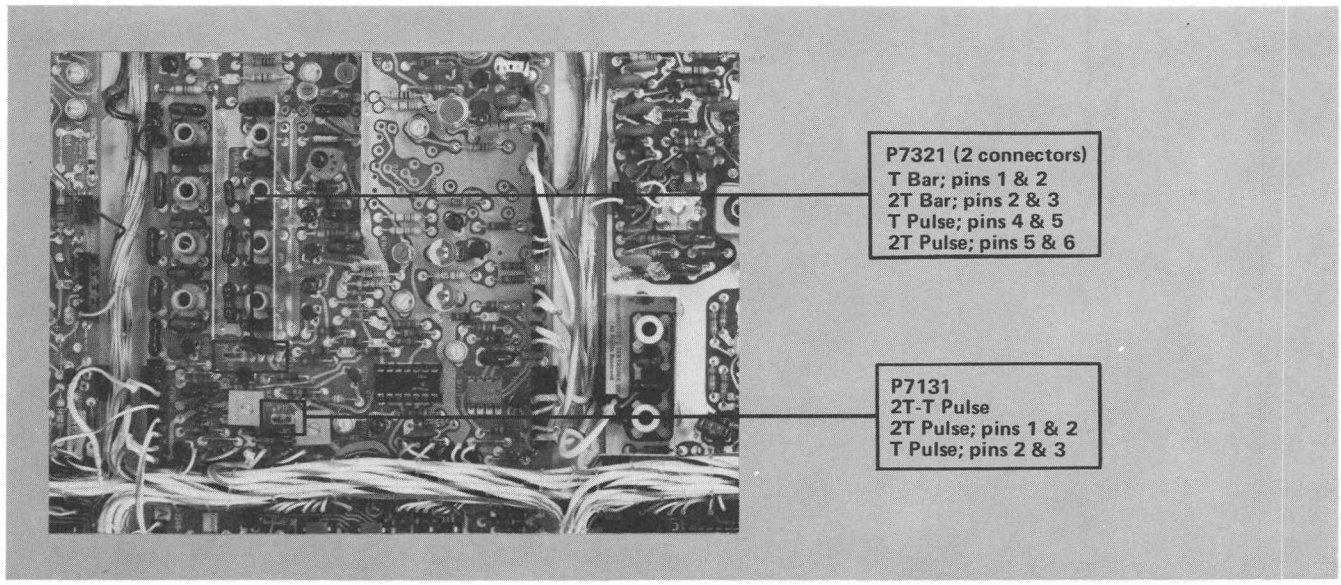


Fig. 2-14. Output Amplifier circuit board location of P7131 and P7321.

2T/T Sine-Squared Pulse

As factory connected, the 149 displays the 2T Pulse. To display the T Pulse in place of the 2T Pulse, (1) change the connector on pins one and two of P7131 (see Fig. 2-14) to pins two and three and (2) change the connector on pins five and six of P7321 to pins four and five.

2T/T Bar (Integrated Sine-Squared Pulse)

As factory connected, the 149 displays the 2T Bar. To display the T Bar in place of the 2T Bar, change the connector on pins two and three of P7321 to pins one and two.

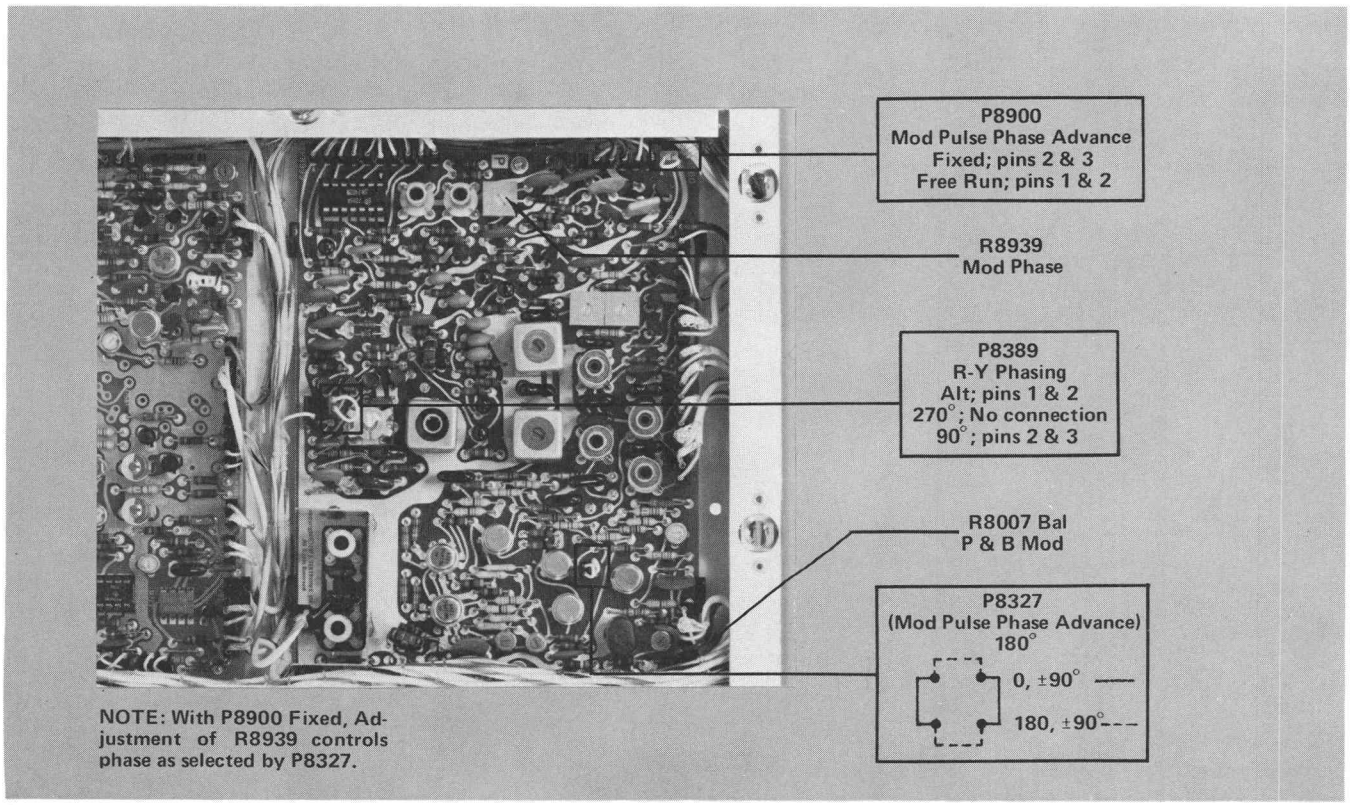
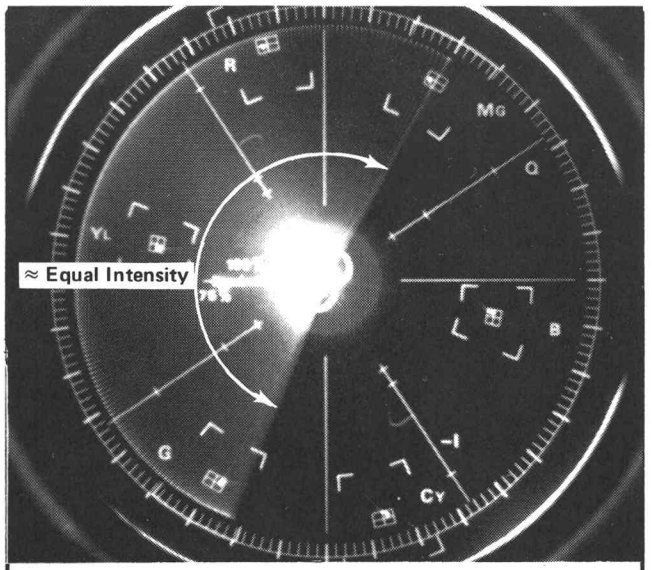


Fig. 2-15. Modulator circuit board location of selector plugs and adjustments.

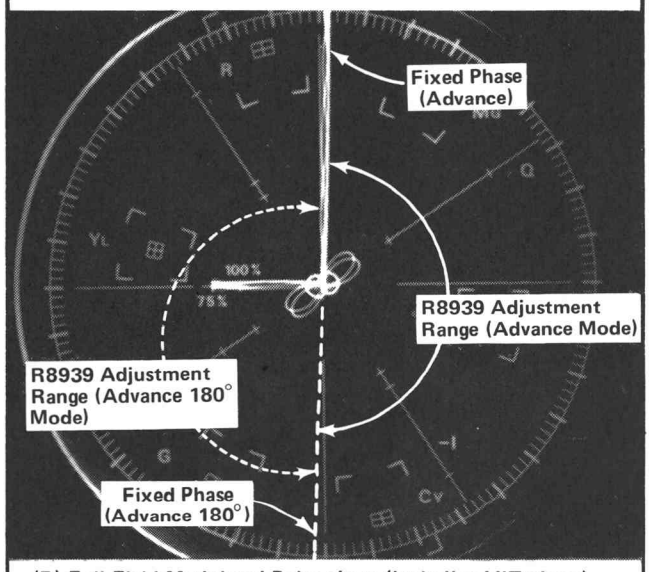
Modulated Sine-Squared Pulse Phase Advance/ Advance 180°

The following changes have been grouped because of interaction.

Phase Advance. As factory connected, the phase of the Full Field Modulated Sine-Squared Pulse is not fixed. This can be demonstrated by observing the 149 FULL FIELD SIN² PULSE AND BAR test signal on a vectorscope. A fan-shaped display, as shown in Fig. 2-16A, will be observed. This enables the test signal to be used where measurement accuracy is of prime importance.



(A) Full Field Modulated Pulse phase; normal operating mode.



(B) Full Field Modulated Pulse phase (including VIT phase) advanced and advanced 180° operating mode.

Fig. 2-16. Typical vectorscope display of the modulated pulse in (A) normal mode and (B) advance mode.

By changing the connector on pins one and two of P8900, see Fig. 2-15, to pins two and three, the phase of the Full Field Modulated Sine-Squared Pulse will be fixed. This is shown in Fig. 2-16B.

Once Phase Advance has been established, adjustment of R8939 (Mod Phase) can be used to vary the fixed phase approximately 180°.

NOTE

In the Phase Advance mode, the Full Field and VIT Modulated Sine-Squared Pulse have the same phase. This allows source coding of the VIT.

Advance 180°. As discussed above, it is possible to obtain Phase Advance of the Modulated Sine-Squared Pulse during VIT. If needed, the phase can be changed 180° from that obtained with adjustment of R8939 by rotating the connector on P8327 (see Fig. 2-15) 90°. This provides a 360° control range of the VIT phase.

NOTE

The Phase of the Full Field signal will also be advanced 180° in this mode.

This connection requires internal adjustment.

Adjustment Procedure

1. Observe the SIN² PULSE AND BAR FULL FIELD TEST SIGNAL OUT.

2. Adjust R8007 (P and B Mod Ball), see Fig. 2-15, for minimum modulation on the blanking level.

Modulated Pedestal Half Line

As factory connected, the MODULATED PEDESTAL COLOR TEST SIGNAL is in accordance with STOC Test Signal No. 2. If desired, the horizontal timing may be changed for utilization of active line time.

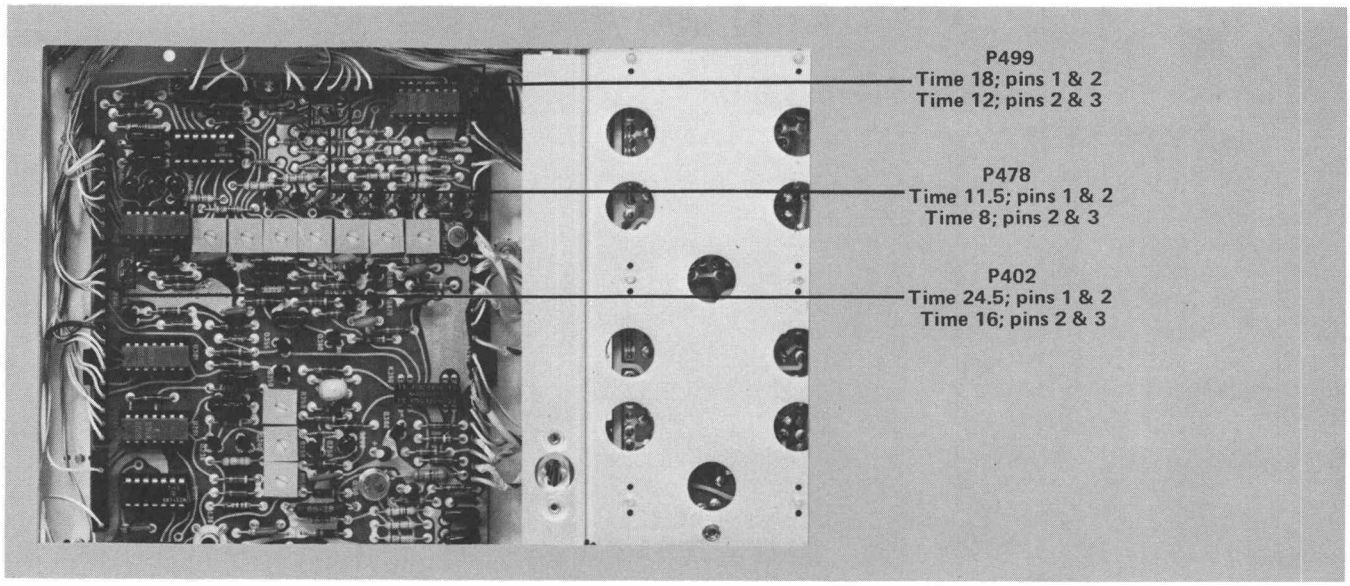


Fig. 2-17. Subcarrier and Sync Out circuit board location of selector plugs.

Proceed as follows: (1) Change the connector on pins one and two of P402, see Fig. 2-17, to pins two and three; (2) Change the connector on pins one and two of P478 to pins two and three; and (3) Change the connector on pins one and two of P499 to pins two and three.

With the above connections, the MODULATED PEDESTAL will be as shown in Fig. 2-18.

Color Bar R-Y Phase

As factory connected, the color bar R-Y phase is locked to 90° (normal NTSC operation). For test purposes, the R-Y phase can be locked to 270° by removing the connector on P8389, see Fig. 2-15. For Quadrature phase testing, the R-Y phase can be alternated between 90° and 270° by connecting pins one and two of P8389.

Remote Control Monitoring

For remote control operation of TV transmitters[3], the FCC requires that specific vertical interval test signals be inserted and monitored by the broadcaster. The test signals required are a reduced amplitude multiburst, color bar, and a composite signal. The test signals are shown in Fig. 2-19 and are in compliance with FCC Rules and Regulations § 73.699, figures 13, 14, and 15.

The required test signals are generated by the 149 and programmed in compliance with FCC Rules and Regulations § 73.676 (f) for remote control monitoring. It is recommended that the following be referred to for additional information—"Test Signals and Their Monitoring For Remote Control of Television Transmitters", Charles W. Rhodes; BME, February 1972.

[3] Amendment of Part 73, Subpart E of The Commissions Rules and Regulations Governing Television Broadcast Stations Concerning the Operation of VHF and UHF Television Broadcast Stations by Remote Control, Second Report and Order, Docket No. 18425, FCC-71879, 8-18-71.

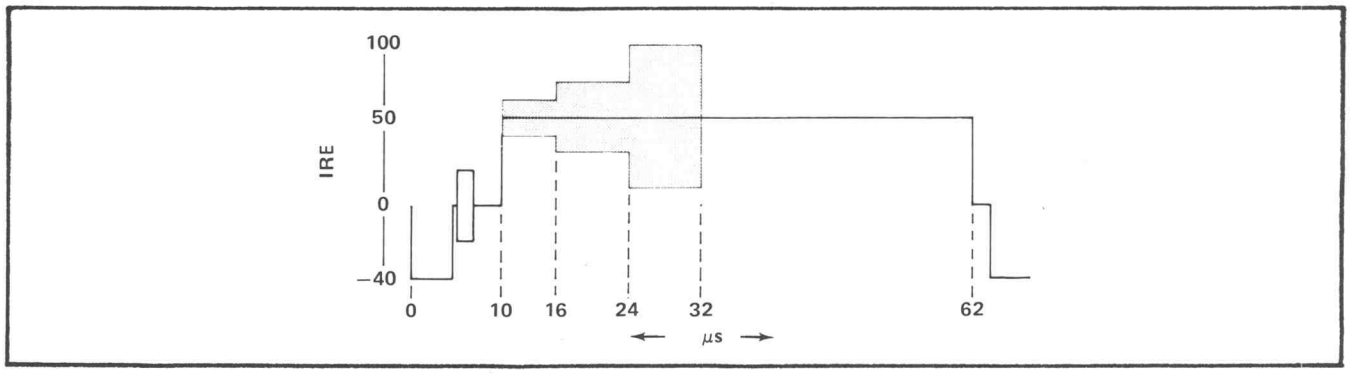
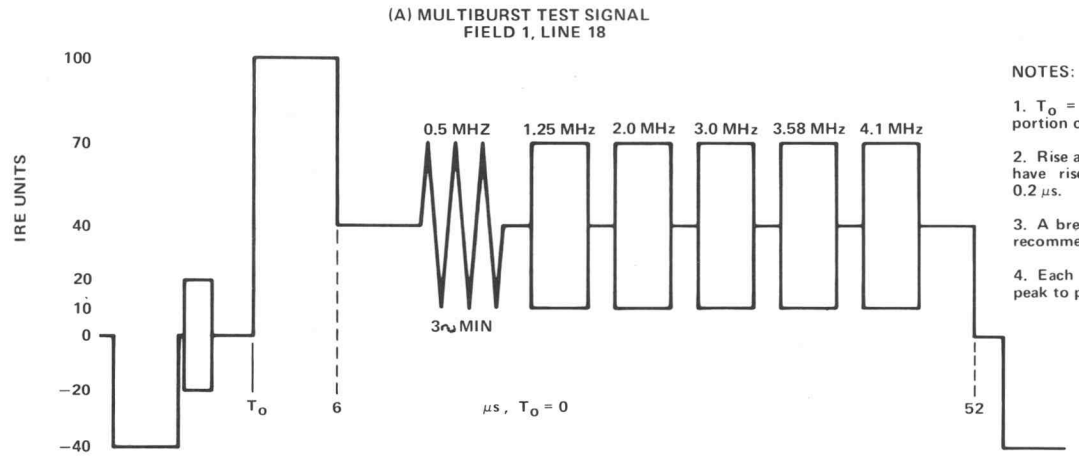
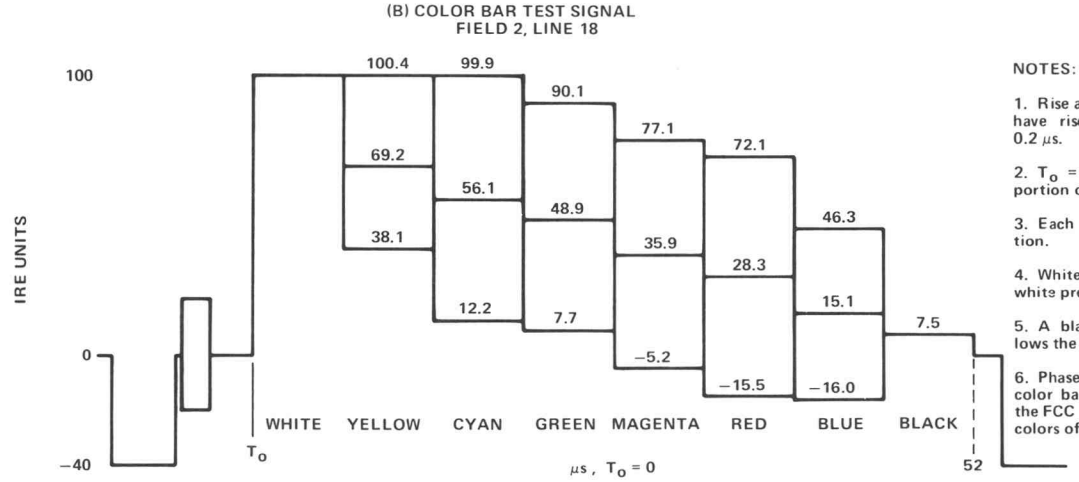


Fig. 2-18. Modulated Pedestal; half line option.



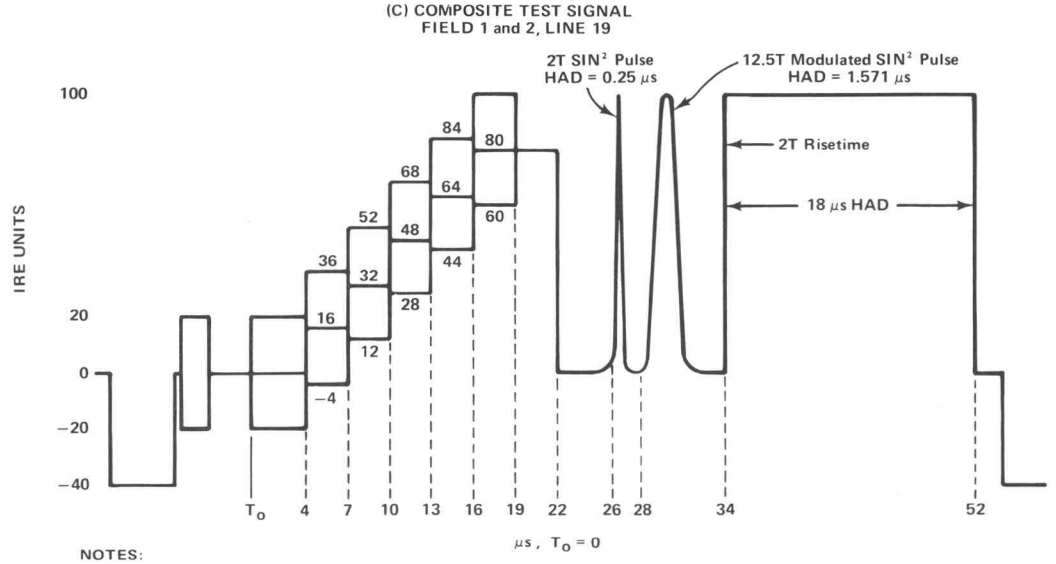
NOTES:

1. T_o = Nominal start of active portion of Line 18, Field 1.
2. Rise and Fall of white bar shall have risetime of not less than 0.2 μs.
3. A breezeway between bursts is recommended.
4. Each burst packet = 60 IRE peak to peak.



NOTES:

1. Rise and Fall of white bar shall have risetime of not less than 0.2 μs.
2. T_o = Nominal start of active portion of Line 18, Field 2.
3. Each bar 6 μs minimum duration.
4. White flag (bar) at reference white precedes the color bars.
5. A black burst setup level follows the color bars.
6. Phases and amplitudes of the color bars are in accordance with the FCC R & R for 100% saturated colors of 75% Amplitude.



NOTES:

1. T_o = Nominal start of active portion of LINE 19, Field 1 and Field 2.
2. Rise and decay of all luminance signals not less than 0.2 μs.
3. Rise and decay of envelope of sub-carrier component of staircase signal shall be ≈SIN² shaped and risetime .375 μs.

Fig. 2-19. Test signals to be generated and inserted in the vertical interval for Remote Control Monitoring. Reference: FCC Rules and Regulations, Section § 75.696 (f) Figures 13, 14, and 15 of Section § 73.699; ammended Part 73 of the Rules and Regulations, October 6, 1971.

GLOSSARY OF TERMS

ACTIVE VIDEO LINES: All video lines not occuring in the vertical blanking interval.

APL: Average picture level. The average signal level, with respect to blanking level, during active picture scanning time, expressed as a percentage of the difference between the blanking and reference white levels.

BACK PORCH: That portion of the composite video signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLACK BURST: A signal consisting of composite sync and burst. Normally has setup.

BLANKING LEVEL: The level of the front and back porches of the composite video signal. Normally at 0 IRE.

BREEZEWAY: In NTSC color, the portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BURST FLAG: Pulses used to key out a portion of the 3.579545 MHz sine wave subcarrier for use as a reference for the color signal.

CHROMINANCE: That property of light which produces a sensation of color in the human eye apart from any variation in luminance that may be present.

COLOR BAR: A test signal, typically containing eight basic colors: white, yellow, cyan, green, magenta, red, blue, and black, which is used to check the chrominance functions of color TV systems.

COLOR BURST: In NTSC color systems, this normally refers to a burst of approximately 8 to 10 cycles of 3.579545 MHz subcarrier frequency on the back porch of the composite video signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER: In color systems, this is the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information; in NTSC, it is a 3.579545 MHz sinewave.

COMPOSITE BLANKING: This signal is composed of pulses at line and field frequencies used to make the return traces of a picture tube invisible.

COMPOSITE SYNC: The line and field rate synchronizing pulses (including the field equalizing pulses) when combined together form the composite sync signal.

COMPOSITE VIDEO: For color, this consists of blanking, field and line synchronizing signals, color synchronizing signals, chrominance and luminance picture information. These are all combined to form the complete color video signal.

DIFFERENTIAL GAIN: The difference between (1) the ratio of the output amplitude of a small, high-frequency sine-wave signal at two stated levels of a low frequency signal on which it is superimposed and (2) unity.

DIFFERENTIAL PHASE: The difference in output phase of a small high-frequency sine-wave signal at two stated levels of a low-frequency signal on which is is superimposed.

EIA: An abbreviation for Electronic Industries Association.

EQUALIZING PULSES: Pulses of one half the width of the horizontal sync pulses which are transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulses. The purpose of these pulses is to cause the vertical deflection to start at the same time in each interval, and also serves to keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD: One half of a complete picture (or frame) interval, containing all of the odd, or all of the even, lines of the picture.

FIELD BLANKING: Refers to the blanking signals which occur at the end of each field. Also called vertical blanking.

FIELD FREQUENCY: The rate at which one complete field is scanned, normally 59.94 times a second in NTSC.

FRAME: One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH: That portion of the composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding sync pulse. Normally 1.59 μs.

GEN LOCK: Subcarrier to burst lock.

H RATE: The time for scanning one complete line, including trace and retrace. NTSC equals 1/15734 second (color) or 63.56 μs.

IRE: An abbreviation for Institute of Radio Engineers.

IRE SCALE: An oscilloscope scale that applies to composite video levels. There are 140 IRE units in 1 volt.

LINE BLANKING: The blanking signal at the end of each scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY: The number of horizontal scans per second, normally 15,734.26 times per second in NTSC.

LUMINANCE (Y): The amount of light intensity, which is perceived by the eye as brightness (referred to as 'Y').

NTSC: National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

REFERENCE WHITE LEVEL: The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

SETUP: The separation in level between blanking and reference black levels. Normally 7.5 IRE.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by the subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

SYNC: An abbreviation for the words 'synchronization', 'synchronizing', etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

VERTICAL BLANKING INTERVAL: The blanking portion at the beginning of each field. It contains the equalizing pulses, the vertical sync pulses, and VITS (if desired). Presently 18-21 lines duration.

VERTICAL DRIVE: A pulse at field rate used in TV cameras. Its leading edge is coincident with the leading edge of the vertical blanking pulse and its duration may be 10.5 lines.

VIRS: Vertical Interval Reference Signal. A reference signal proposed by the B.T.S. for use on line 20.

VITS: Vertical Interval Test Signal. A signal which may be included during the vertical blanking interval to permit inservice testing and adjustment of video transmission.

SECTION 3
CIRCUIT DESCRIPTION

General

This section of your manual describes the electrical operation of circuits within the 149 using a "block" rather than a "part" description. The description is organized with respect to the individual diagrams, plus the master block diagram given on a separate pull-out page in the Diagrams Section. Each block described is clearly shown on these diagrams. Where new or unusual circuitry is used or where additional detail is necessary, it is fully explained.

The 149 can be considered as in Fig. 3-1. Basically, the 149 consists of (1) a Relay to provide bypass in the event of loss of sync, instrument malfunction, etc., (2) Sync and Subcarrier processing circuits to detect synchronization information, (3) Timing circuits to provide gate signals used for generation of the output signals, (4) Test Signal Generator to generate the various output signals, (5) Program Control Switching to allow the operator to select the mode of operation, (6) Electronic Switches to route all

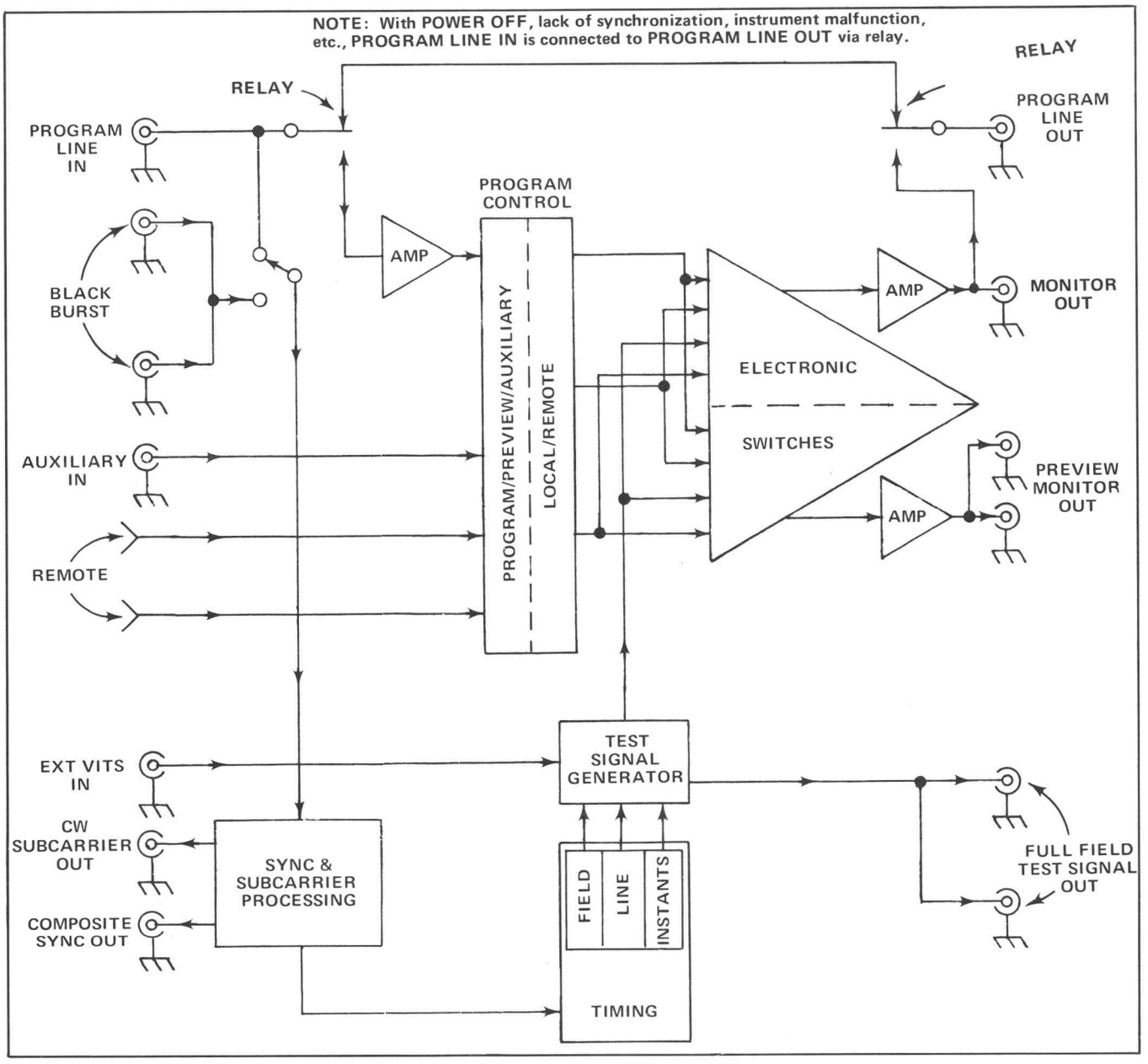


Fig. 3-1. Basic block diagram of the 149.

signals to the proper outputs at the proper time, and (7) Output Amplifiers to provide sufficient current to drive the outputs.

Diagram 0 a & b

The circuitry shown on diagram 0_a (Program Line Amplifier) is used to condition the input signal applied to the PROGRAM LINE IN for further processing (required for insertion of signals), and selects the mode of operation. The circuitry shown on Diagram 0_b (VITS Inserter) routes internally generated and externally applied signals during selected intervals so that a composite of each is available at the PROGRAM LINE OUT, PROGRAM MONITOR OUT, or PREVIEW MONITOR OUT connectors.

Relay

The relay circuitry is used to bypass the program signal to the PROGRAM LINE OUT in the event of circuit failure, loss of power, etc., or apply the program signal to the active circuits within the 149 for processing. The relay is activated by a control signal developed on diagram 9 which, in turn, is dependent upon the presence of external sync. (See discussion of Sync Lock Detector for further information.)

Gain

The Gain stage is an AC coupled operational amplifier with unity gain or variable gain (front-panel LEVEL) of the program signal. AC coupling removes any DC component that may be applied via the PROGRAM LINE IN.

Q540 provides constant current for emitter coupled amplifier Q510 and Q520. Current through Q520, set by R9205 (LEVEL) or R505 (dependent upon the setting of S9205, UNITY GAIN/VAR), flows through R625 (Rf of operational amplifier Q620-Q630) to set the overall circuit gain. The signal at TP820 is applied to the VIRS Detector (see discussion of diagram 9), and the VIT Switches (after DC restoration).

Clamp Pulse Generator

The stage is used to generate a pulse during back porch time to drive the clamps.

Q905, normally on, is driven by composite sync (negative-going). On the trailing edge of each sync pulse, Q905 turns off (current shunted via Q900), producing a pulse which is differentiated by C910 and R926. When Q905 turns back on, the differentiated pulse turns Q920 (normally on) off. A negative-going pulse (which has been delayed from sync), is obtained at the collector of Q920, such that during back porch time, the circuit DC-restores the signal appearing at TP801.

Clamp

Q820 is the active circuit element of this stage. During back porch time, it is biased on, which effectively grounds TP801. This DC-restores the signal via C804 in the gain stage.

Program Control Switching

Consisting of S9212 and S9213, this stage selects the mode of operation: PROGRAM, PREVIEW, or AUXILIARY, and LOCAL or REMOTE.

VITS Switches

U761 and U861 are used to route the program signal (or auxiliary signal in AUXILIARY mode) to the Output Amplifiers, except when VITS is inserted during the vertical interval. During VITS time, the switches route internally generated signals to the Output Amplifiers as programmed VITS.

Basically, the circuitry acts like two double pole-double throw switches. In one position, signals applied to pins 2 and 15 reach the differential output, pins 12 and 13. In the other position, signals at pins 7 and 10 reach the output. Switching between the two channels of each switch is dependent upon the condition of pin 4. (See diagram 0_b.) Signals reaching the output of each switch are also dependent upon the condition of pin 6 (if high, no output will be obtained). Thus, the incoming program signal (or auxiliary) is applied to one channel, the internal signal to the other; dependent upon Program Control Switch settings, a combined output is obtained.

VITS Gate

As discussed above, VITS switching is dependent upon the condition of U761 pin 4 and U861 pin 4. This stage is used to steer a control signal to pin 4 of each switch so that insertion may occur. Q560, Q570, and Q658 are the active elements of this stage.

For the discussion that follows, assume that the PREVIEW mode of operation is selected, and that a VITS is internally programmed to appear during the vertical interval. Under these conditions, the signal at the PROGRAM OUT and MONITOR OUT is the same signal applied to the PROGRAM IN; the signal at the PREVIEW MONTIOR OUT is the PROGRAM IN signal, plus the internally generated and inserted VITS. For these conditions to exist, pin 4 of U761 (program switch) must be held low at all times to inhibit insertion in the monitor channel.

In addition, pin 4 of U861 (preview switch) must be held low, except during VITS time.

CR585 and CR588 are forward biased, shunting current away from Q560 and Q570. With Q560 and Q570 off, pin 4 of each VITS gate is low and only the program signal appears at the respective outputs. During VITS time, a VITS key pulse (via P591-3) reverse biases CR588 to switch current through Q570. Pin 4 of U861 goes high, allowing the VITS (via pin 7 of U861) signal to be routed to the PREVIEW MONITOR OUT.

In PROGRAM or AUXILIARY mode, the circuit operation is similar to that discussed, except that Q560 is on (CR585 reversed biased) at all times, but because of Q658, normally off, no VITS are inserted except when Q570 is turned on.

Output Amplifier

The Output Amplifiers are operational amplifiers driven by current developed by the differential voltage across R765 and R965. This current, through R978 and R868, Rf for each amplifier, sets the gain of each stage. These operational amplifiers provide the low impedance necessary to drive the PROGRAM OUT, MONITOR OUT and PREVIEW MONITOR OUTPUTS.

Relay Mode Indicator

This stage, consisting of emitter follower Q580, is used to shut off the Program VIT switch in a Bypass Mode. Should the relay open, (PROGRAM LINE IN to PROGRAM LINE OUT) cross-talk between the monitor and program outputs could occur. By turning off U761 (pin 6 of U761 high), no cross-talk is introduced.

Lamp Drive

Q565, an emitter follower, provides drive for the PROGRAM and PREVIEW lamps.

DIAGRAM 1

The Vertical and Horizontal Counter circuitry synchronizes the 149 to the incoming program composite sync (or black burst), and generates all timing signals required for operation of the 149.

Horizontal Integrator, AFC Sampler, 1 MHz Oscillator, Divide-By-64 Counter, and Delayed Feedback

A 1 MHz oscillator generates a pulse which is counted down to the line rate. The line rate gate is then compared to the external composite sync. Any timing error between these two signals will produce an error voltage to change the oscillator frequency. This action keeps the ÷ 64 counter in step with the external sync.

1 MHz Oscillator. Q1691 and Q1791 are the active components for the 1 MHz oscillator. CR1740 and L1670 are the frequency-determining constants. Sustaining feedback is provided via C1798 and C1995. The output of the oscillator, TP1480, consists of positive-going pulses (limited sine-waves) which are then used to toggle the Divide-By-64 Counters.

Divide-By-64 Counter. U1391, U1361, and U1431 form the stage. Each counter is level sensitive (positive) and divides the 1 MHz toggle pulses in a divide-by-2, divide-by-4, ..., divide-by-64 sequence.

Delayed Feedback. U1461C combines three of the Divide-By-64 Counter outputs to produce a negative gate, approximately 8 μs wide, each horizontal line. During the 8 μs negative interval, this pulse disconnects CR1795, which allows C1780 to charge towards +15 volts (from 0 volts) at an approximate rate of 0.5 V/μs. (Charge path via R1893 and R1760.)

The ramp is then compared against the setting of R9209 (Insert Delay) by voltage comparator Q1731 and Q1741. When the ramp voltage exceeds the delay voltage, Q1731 is turned off and a ringing pulse is developed across L1850. This pulse is then peak-detected by CR1930 to drive the AFC Sampler.

AFC Sampler. Q1921 and Q1721 form the AFC Sampler. When Q1921 is turned on, Q1721 acts as a gate which allows the voltage obtained by the ramp in the Horizontal Integrator to be transferred to the variable capacitance diode CR1740, which controls the 1 MHz Oscillator.

Horizontal Integrator. During sync time, this stage produces a ramp which is sampled to control the 1 MHz Oscillator. Composite sync is coupled to switching pair Q1801-Q1811. This switch, during sync time, allows current determined by R1820 to charge C1902 via Q1811. This produces a positive (approximately 3 V/μs) ramp, made linear by Q1911. At approximately 4.7 volts positive, Q1901 is saturated to clamp the ramp, preventing breakdown of Q1721 in the AFC Sampler circuit.

At the end of sync time, Q1801 is turned on, and current via R1810 causes the ramp to go in a negative direction towards 0 volts at an approximate rate of

2.5 V/μs, made linear by Q1911. Ramp voltage at sample time is transferred via the AFC Sampler stage to the 1 MHz Oscillator, which brings the ÷ 64 Counter into step with the external sync.

Vertical Integrator

The vertical integrator produces a ramp during the vertical serration pulses, which is then peak-detected and used to set the Field Counter and Field Recognition circuits. This integrator is similar to the horizontal integrator except for circuit values.

Peak Detector

On the last vertical serration pulse, Q1411 is biased on, producing one negative pulse per field to drive the Field Counter and Field Recognition circuit.

Field Recognition

U1301A, U1301D, and Q1401 are the active components of the set-reset stage, and identify field 1 and field 2.

The circuit is driven by the field pulse (obtained in the Vertical Integrator) every 262.5 lines, and by the 8 μs gate pulse (via the ÷ 64 counter) each line. The set-reset stage recognizes field 1 (and changes state) when the 8 μs gate and the field pulse are coincident; no coincidence with the pulse is required for field 2 recognition. See Fig. 3-2 for timing waveforms.

Clock

This stage is driven by pulses corresponding to instants 15 and 31 (see Operating Instructions or diagram 2_a for details). The pulses are used to toggle the Divide-By-525 Counter.

Divide-By-525 Counter

The counter generates the various timing gates required for one-half line offset used in interlace scanning. The counter is initially set to a count of 499 by a pulse obtained in the Vertical Integrator. It is then toggled from the Clock stage, counting to 1024 in a divide-by-2, divide-by-4, ..., divide-by-1024 sequence. On the 1024 count, the counter is reset to a count of 499 and the sequence is repeated. (1024 − 499 = 525.) However, only the initial preset of the counter is from the Vertical Integrator as the counter is self-setting.

Matrix

The matrices are used to combine the various timing signals from the Divide-By-525 Counter into timing-gate pulses corresponding to Vertical Blanking, Field Square Wave, Window, and the 9 Line Keyout.

VIT H Blanking

U1331B and U1461A combines the various timing signals from the Divide-By-64 Counter so that U1301B and C (a set-reset) provides the required horizontal blanking that is used to gate (switch) the VIT signals into the program signal during VIT time.

DIAGRAM ◇2◇ a & b

The Horizontal Timing circuitry combines the various signals generated by the Vertical and Horizontal Counters into timing pulses required to generate all test signals.

Instant Decoder

U2001 and U2401 are used to decode the various outputs from the Divide-By-64 Counter. Decoding provides

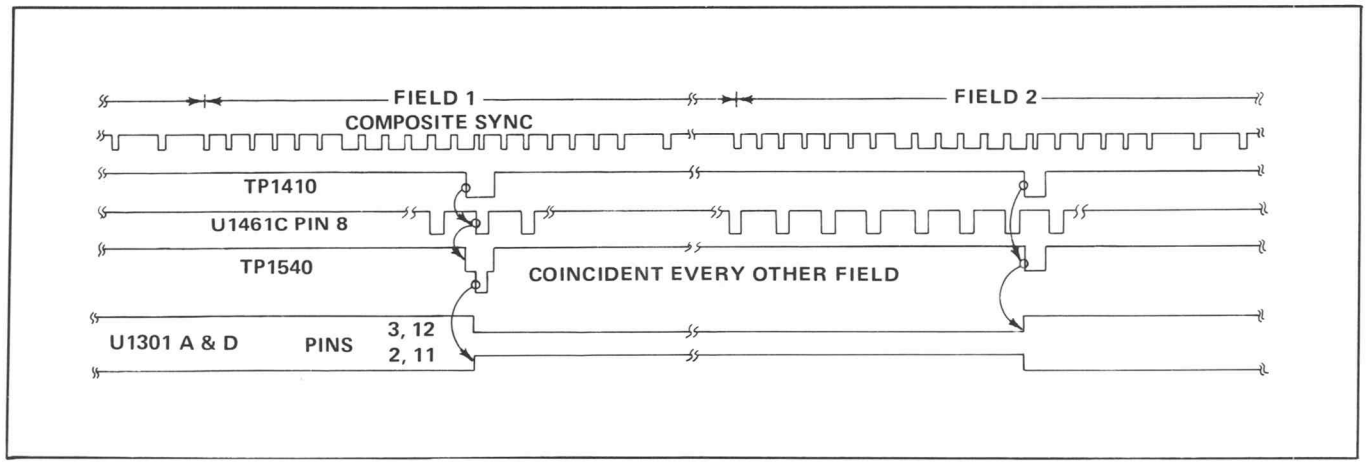


Fig. 3-2. Field recognition timing waveforms.

32 outputs, approximately 2 μs apart

$$\left(\frac{63.56\ \mu s}{32}\right),$$

each having a 1 μs negative-going pulse once each line. Each decoded output (Characteristic Instant, see Operating Instructions for details) can be programmed by the operator so that internally generated signals can be time-positioned within a line as desired.

Set-Reset Circuits

These IC's provide the timing signals as programmed for generation of the output signals.

Staircase Generator Logic

These two stages arrange timing information into a matrix for use in generating the LINEARITY test signals.

Staircase Modulation Logic

This stage provides a pulse which enables modulation to be inserted on the LINEARITY test signal.

Composite 5 Step Timing

This stage arranges timing information into a matrix for use in generating the staircase portion of the COMPOSITE test signal.

MB Width

This stage arranges timing information into a matrix for use in setting the width of each multiburst packet.

Pulse Timing

This stage provides the timing signals necessary for the pulse of the SIN^2 PULSE & BAR or COMPOSITE test signal.

Bar Timing

This stage provides the switching pulse for the bar of either the SIN^2 PULSE & BAR or COMPOSITE test signal.

Mod Pulse Timing

This stage provides the timing pulses required for the modulated sine-squared pulse.

1/2 Instant Delay

This stage, consisting of U2931E and U2961D is used to shift any Characteristic Instant 1/2 μs. These 1/2 Instants are then used to time the set-resets. (See Operation Instructions for details.)

DIAGRAM 3 a & b

The circuitry on diagram $3_{a\ \&\ b}$ is used: (Color Bar Drive) to provide signal currents which correspond to the R-Y, B-Y, and luminance (Y) portions of the color test signal, and (Staircase & APL) to generate the LINEARITY and FLAT FIELD test signals. (See Fig. 3-3 for Color Bar Drive timing information.)

Color Test Signal Logic

This stage, controlled by front-panel switches, enables the Color Bar Chrominance Drive and Color Bar & Modulated Pedestal Luminance Drive stages.

Color Bar Drive

U3210 combines 8 timing pulses, which are used to set the width and starting point of the color test signal.

Color Bar Chrominance Drive

U3220, a Divide-By-16 Counter, provides timing gates which correspond to the time of Red, Green, and Blue.

Color Bar Amplitude

Q3020, Q3040, and Q3030 form the R-Y current; Q3050, Q3060, and Q3070 form the B-Y current.

Basically, each stage consists of a current switch. When current is switched through the transistor the desired output will be obtained.

Delay

Q3367 introduces a fixed amount of delay (approximately 20 ns) so that the luminance and chrominance components of the color bar signal are properly combined at the output.

Luminance Amplitude

This stage is similar to the Color Bar Amplitude, except that currents derived in this stage correspond to the luminance (Y) portion of the color test signal, or the luminance level of the modulated pedestal.

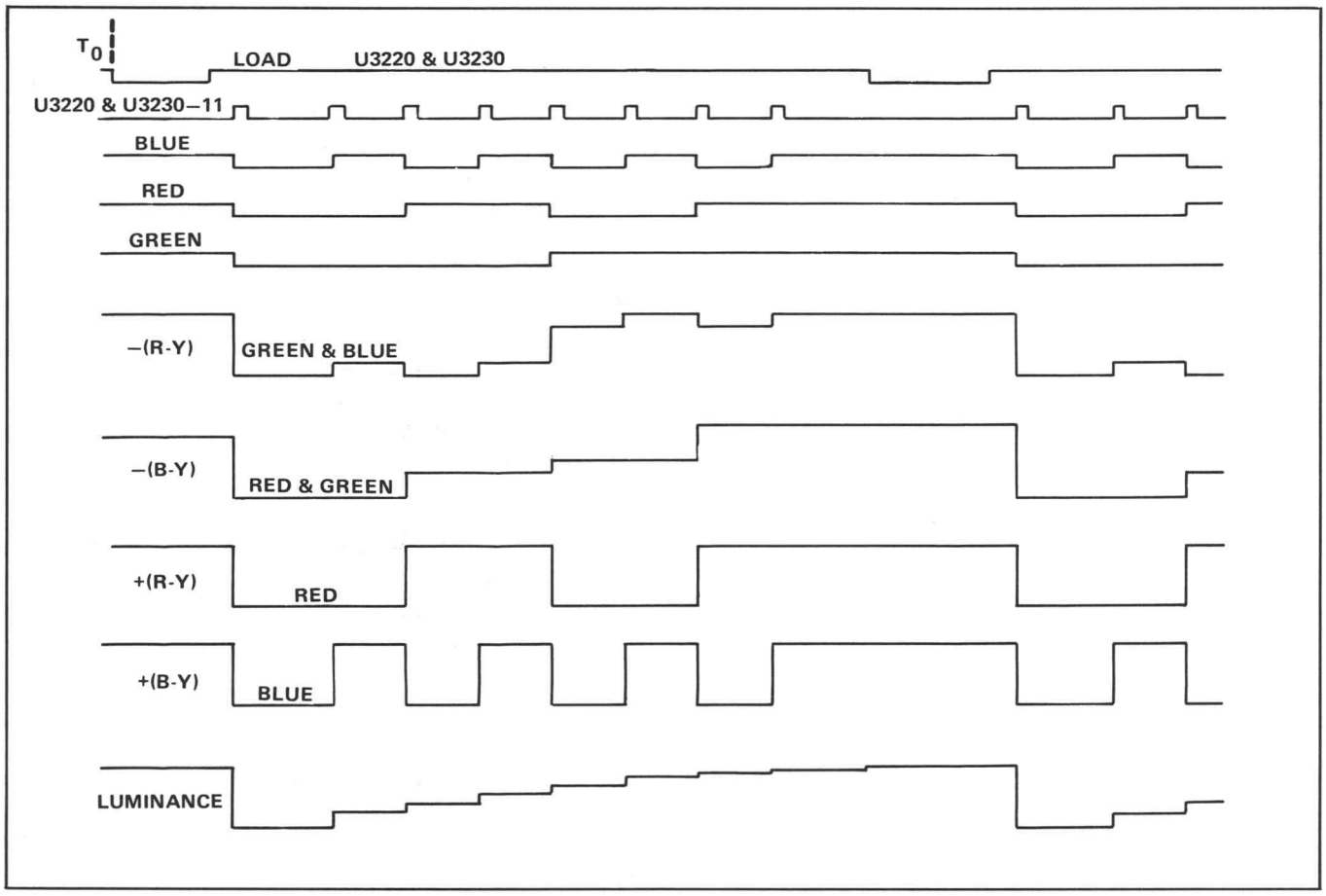


Fig. 3-3. Color Bar Drive timing waveforms.

Field Square-Wave

This stage consists of a multivibrator and current switch. The multi is used to shift the Field Square-Wave so that it ends coincident with the end of a line rather than at the center of the line. This is because the Field Square-Wave is obtained from the Divide-By-525 Counter, which is operating at a one-half line rate. The output of the multi then controls the current switch. The current is switched into the output amplifier to obtain the pedestal amplitude of the FIELD SQUARE-WAVE test signal.

Window

This stage is identical to that of the Field Square-Wave, except the output of the multi controls the Window Logic stage (see discussion with diagram 4_b) rather than controlling a current switch.

Bounce Rate Generator

This circuitry consists of a modified Bowes Oscillator (Q3890 and Q3880) which is front-panel controlled (RATE). This allows the oscillator frequency to be changed from ≈ 1 to greater than 10 seconds. The output is then used to control the Bounce Current Generator.

Bounce Current Generator

This stage consists of three current switches to set the level of the FLAT FIELD test signal. Q3825 supplies the 10% current, Q3820 supplies the 90% current, and Q3720 supplies the current for the variable. The diodes located in the collector circuit of each current source, switch the current on or off; the diodes in the emitters control the switching between 10%, 90%, and VARIABLE APL.

Linearity Modulation

This stage is a programmable current switch that provides sufficient current to the modulator for either the 20 or 40 IRE subcarrier modulation on the LINEARITY test signal.

Staircase Switch Logic

This stage combines the various timing and gate signals for use by the Staircase Generator.

Staircase Generator

This stage consists of an integrator, reset circuit, 10-step current switch, 5-step current switch, and a ramp current switch, all of which are used to produce the LINEARITY test signal.

C3441 and C3443 are the integrator feedback capacitors. Q3540 resets the integrator. For a 10-Step Staircase, the charge on C3461 and C3470 is transferred to the integrator to produce the step. For a 5-Step Staircase, the charge on C3473 and C3565 (twice that of C3461 and C3470) is transferred to the integrator. For the Ramp, the current through R3616 is fed into the integrator to produce a ramp. The output of the stage is then applied to the Luminance Amplifier for further processing.

DIAGRAM 4

The VIT and Full Field Logic circuitry is used to allow programming of the VIT signals, to matrix all timing used to produce the test signal outputs, and to control the indicator lamps.

Sync Reset

This circuit prevents any VIT signals from being inserted into the vertical interval, should loss of vertical sync occur.

Divide-By-16 Counter

The counter generates gate signals for use in the Decoder. The counter is toggled by instant 1, which occurs in each active line, and produces the required gate signals to drive the Decoder.

Decoder

The Decoder provides one output per line. Each output corresponds to one line of the vertical interval for lines 10 through 21.

Matrix

This stage allows programming of the various VIT signals. (See the Operating Instructions.)

Modified Vertical Blanking

The circuit shifts the vertical blanking signal so that it ends on line 22. This inhibits the first and last half of line 21 from being generated during Full Field signals.

VIT Spare

This circuitry allows programming 2 of 3 signals. (Refer to the Operating Instructions for details.) It also allows the use of 6 programming lines for 7 different VIT signals.

VIT "OR"

The stage has three functions. First, it produces a drive pulse to switch the diode gate (see diagram 0_b). Secondly, should loss of sync occur, it allows only the internally-generated sync and burst to be gated onto the MONITOR OUTPUTS. Finally, it gates sync and burst onto the auxiliary signal when the 149 is operated in AUXILIARY MODE.

Logic

The remaining stages on diagram 4 are used for combining the VIT and Full Field gate signals into timing pulses which are then used in the generation of the various test signals.

DIAGRAM 5 a, b, & c

The Gen-Lock circuitry is used to provide reprocessed composite sync and lock the internal 3.58 MHz oscillator to the incoming burst signal.

Sync Separator Circuit 5a

The circuit removes sync from the externally applied composite video signal. Processing of the composite sync eliminates any degradation of the incoming composite sync, such as white noise, 60 Hz hum, etc.

Processing of composite sync is accomplished by clamping the sync tip level of the external composite video to a predetermined level, then adjusting the blanking level by controlling the overall circuit gain.

Fig. 3-4 is a block diagram of the Sync Separator circuit, and the description that follows is organized with respect to the block diagram and diagram 5_a.

The sync tip of the external video signal (applied to the PROGRAM LINE IN or BLACK BURST IN connectors) is clamped at the sync tip level by the Sync Tip Comparator circuit, consisting of voltage comparator Q5371 and CR5380, operating as a current switch. The comparator is rate-limited and uses the DC-coupled sync to activate it. Once the comparator is switched, any tilt from the field or the line rate sync tips is eliminated. The rate limiting allows the feedback loop (through Q5481 and Q5291) to open at

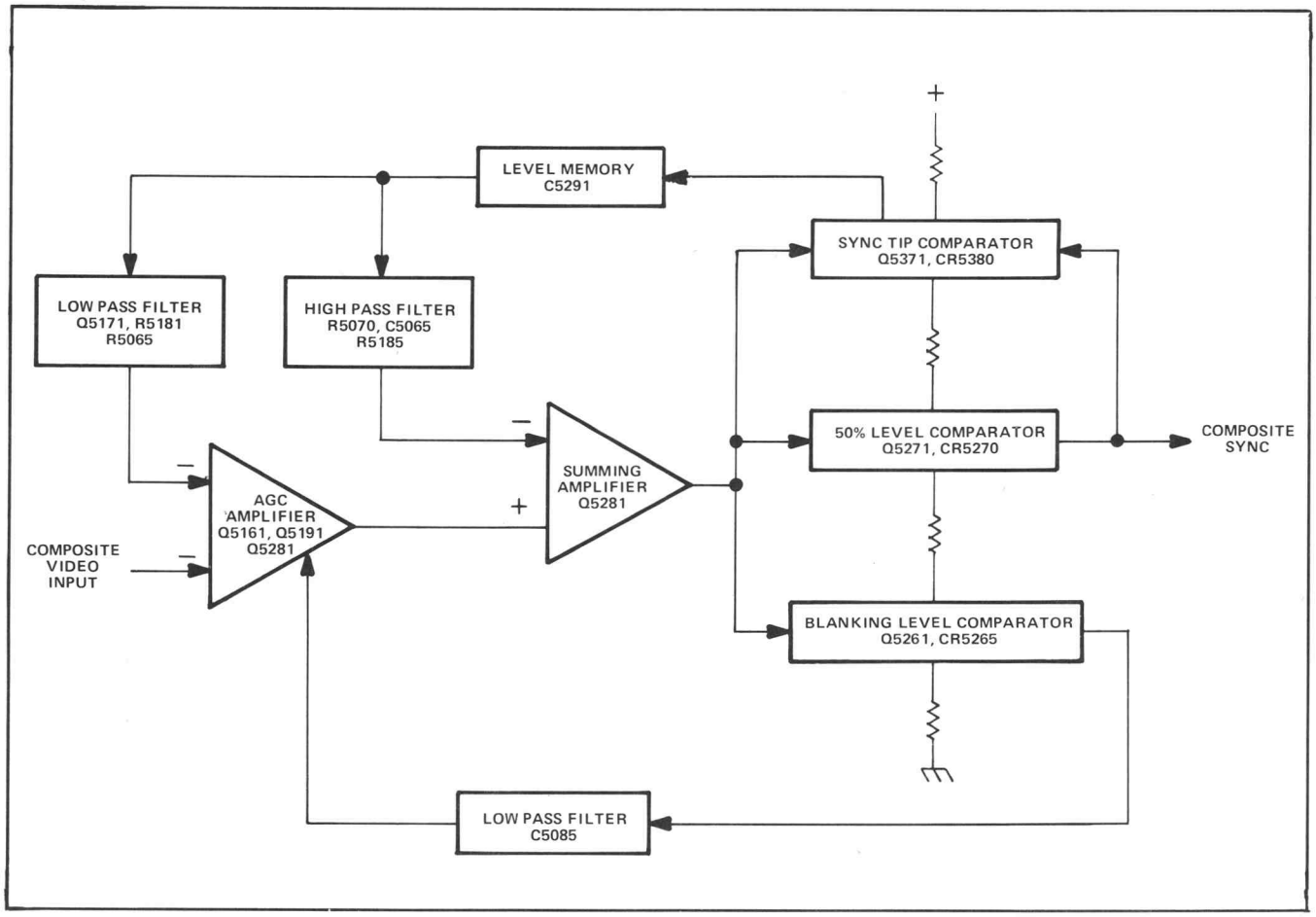


Fig. 3-4. Block diagram of Sync Separator Circuit.

the trailing edge of the sync pulse, and makes the loop unresponsive to impulse noises. It also allows the Level Memory (C5291) to average the white noise on the sync tip during the time the loop is closed. This average determines the sync tip level.

The output from the Level Memory is applied to two filters. The high frequency errors (sync tip tilt) pass through the High Pass Filter, (R5070-C5065) to control the Summing Amplifier (Q5281). The low frequency components are fed back via the Low Pass Filter (Q5171) to drive the AGC Amplifier (Q5161, Q5191, and Q5281). This filtering eliminates most 60 Hz interference.

The 50% Level Comparator (Q5271-CR5270) processes the sync at the 50% amplitude point between the sync tip level and the blanking level, ensuring correct sync width.

The Blanking Level Comparator (Q5261-CR5265) uses the difference in the duty factor between the sync pulse width and blanking width to determine the blanking level. This method allows the entire system to function because timing information is not required to close the AGC loop. The Low Pass Filter (C5085) averages the output of the Blanking Level Comparator; this voltage controls the overall system gain through Q5191.

Back Porch Gate Generator ◇5◇a

The Gate Generator consists of Q5251 and Q5151. It provides gate pulses to the demodulators which correspond to the time of line sync and back porch, or the time of back porch only.

Negative-going composite sync pulses are applied to CR5260 via the sync separator circuit. CR5260 reverse biases on the leading edge of the composite sync and C5258 charges towards −15 V through R5162. The charge path for C5258 is via Q5251 (normally on) and R5162. The trailing edge of the composite sync forward-biases CR5260, which couples a positive pulse through C5258 and turns Q5251 off, producing a series of negative-going pulses at the collector of Q5251. These pulses are coincident with the trailing edge of the line sync, the equalizing pulses, and the vertical sync pulses.

With P5141 in the BURST position (pins 1 and 2 connected), composite sync pulses via R5260 are added to the delayed pulses from Q5251, to drive Q5151. The duration of each output (positive-going) pulse to the demodulators corresponds to the duration of the input line sync and back porch. With the BURST-CW jumper wire (P5141) in the CW position (pins 2 and 3), the output pulse duration to the demodulators corresponds to the time of back porch only.

AGC Subcarrier Amplifier ◇5◇a

The AGC Subcarrier Amplifier consists of the Chroma Trap (C5050 and L5055) and three operational amplifiers in series with external AGC control.

Chroma Pickoff. The trap consists of a series resonant LC circuit (C5050 and L5055). The 3.58 MHz components of the signal, applied to the input, are separated from the external sync by the trap and applied to the Chroma Buffer Amplifier.

Chroma Buffer Amplifier. Q5051 and Q5041 are connected as an operational amplifier with low input impedance. The output (3.58 MHz subcarrier signal current) is regulated by the AGC circuit and applied to a second operational amplifier, Q5031-Q5021.

AGC Operation. The gain control circuit components include Q5141 and CR5035. This circuit regulates the subcarrier signal current (through CR5030 to the input of operational amplifier Q5031-Q5021) by shunting (through CR5035) a portion of the signal current (at the junction of C5042 and C5040) through CR5035 to ground. The amount of current shunted through CR5035 depends on the current demand of Q5141. If the subcarrier signal current is excessive, an increased negative-going corrective signal from the AGC comparator is applied to the base of Q5141. This increases the current through Q5141, which increases the current through CR5035. This decreases the impedance across the diode and shunts more of the signal current away from operational amplifier Q5031-Q5021, thereby decreasing the gain of the amplifier stage.

Limiting Amplifier. Q5031 and Q5021 are connected as a low input impedance operational amplifier with the feedback resistance (R5022) shunted by CR5010, CR5015, and C5022. This provides signal limiting to ensure that the subcarrier (due to peak signals) does not leak through the demodulator during non-demodulation time.

Output Amplifier. The output amplifier (Q5131-Q5231), an operational amplifier, insures adequate drive current for the demodulators. L5101 is adjusted to compensate for subcarrier phase shift errors through the amplifiers.

Quadrature Demodulators ◇5◇b

The Quadrature Demodulator circuits produce output signals which correspond to the amplitude and phase of burst (if any) from the externally applied composite video signal, to control the internal master oscillator.

Quad Phase and Limiting Drivers. Q5511, Q5521, Q5331, and Q5431 are connected as differential comparators. Q5511 and Q5331 are turned on and off, at the subcarrier rate, during line sync and back porch time (or back porch only) to provide switching current to the demodulators. Q5521 and Q5431 are driven by the internally generated subcarrier signal, with Q5521 operating 90° later than Q5431. Subcarrier delay is provided by L5601, C5615, and C5620. R5610 terminates the line. Quadrature shift allows burst demodulation in any quadrant (demodulation may take place between 0 and 360 degrees). Q5511 and Q5331 are driven simultaneously by the Back Porch Generator. (See Sync Separator and Chroma AGC Amp description.)

Quad Demodulators. The demodulators, Q5241 and Q5311, are forward biased by Q5511 and Q5331 during non-demodulation time. External chrominance from the Chroma AGC Amp is therefore shunted to ground through Q5241 and Q5311. During demodulation time (burst time of the external chrominance signal), Q5241 and Q5311 are switched by the demodulator enable switch at the subcarrier rate. The demodulated chrominance signal is then applied to low-pass filters L5242, C5242, L5320, and C5335. The output of the filters is therefore, a DC level that represents the phase and amplitude of the external burst signal plus the internal subcarrier signal. Under normal operating conditions, the output of Q5241 is 0 volts; the output of Q5311 is a negative DC voltage level during burst time. The output of each demodulator filter drives the AC Pulse Amplifiers.

AC Pulse Amplifiers. Q5351, Q5451, Q5341, and Q5441 amplify the demodulated chrominance signal level obtained from the filters and drive memory capacitors C5540 and C5450.

Reference Clamps. Q5551 and Q5471 hold the inputs to the Quad Phase Burst Rectifiers and Buffer Amplifiers at 0 volts during non-demodulation time. This allows the memory capacitors to charge to a DC level dependent upon the phase and amplitude of the demodulated signal.

During back porch time, a signal applied from the Back Porch Gate Generator turns Q5471 and Q5551 off. This permits the charge on the memory capacitors to drive the Quad Phase Burst Rectifiers and Buffer Amplifiers.

Buffer Amplifiers. Emitter followers Q5561 and Q5571 provide sufficient current to drive the DC Error Amplifier, Quad Lock Detector, and Rectifier circuits. The Buffer Amplifiers also isolate the input to the Quad Phase Burst Rectifiers.

Quad Phase Burst Rectifiers. Q5461 and Q5661 are the active components of this stage, and are connected as phase inverters. This allows detection of the demodulated signal in any quadrant.

During back porch time the charge, if any, on memory capacitors C5540 and C5450 drives Q5461 or Q5661 to produce a positive or negative (depending on phase) output. The more negative pulse is then coupled through one of the diodes CR5570, CR5572, CR5676, or CR5674 to drive the Burst Tip Detector Q5581.

Burst Tip Detector. Q5581, an inverting amplifier, drives the DC Restore Clamps during burst tip time. C5570 holds the level of the last negative pulse applied from the Quad Phase Burst Rectifier stage. This sets the bias of Q5581 near conduction, reducing the time to turn on DC restore clamps Q5591 and Q5681.

DC Restore Clamps. Q5591 and Q5681 restore the DC level of the demodulated chrominance signal (Phase Control and Quad Signals) from the Buffer Amplifiers during burst tip time. When the Burst Tip Detector turns on, both Q5591 and Q5681 are turned on. This clamps the output of the Quad Demodulator stage (TP5690 and TP5580) at about 0 volts.

Burst Lock Disable. Q5491 is the active component of this stage and is used to turn on the DC Restorer Clamps except during Gen-Lock.

With the 149 operated in the non-gen lock mode (no incoming sync), Q5491 is turned on by a signal from the Sync Present Detector (see diagram 9). This turns the DC Restore Clamp transistors on, clamping the output of the Quad Demodulator stage at all times.

Subcarrier Oscillator and Frequency Control <5>C

The Subcarrier Oscillator and Frequency Control circuitry is used to switch the internal 3.58 MHz oscillator from a free run mode to a locked mode or vice-versa.

500 Hz Filter. R5790-C5788 and R5798-C5799 filter the signal pulses from the Quad Demodulators to provide a signal that corresponds to the amplitude and phase of the external burst.

Quad Phase Rectifier. To provide lockup independent of external burst phase errors versus internal subcarrier phase at the moment of Gen Lock attempt, Q5791-Q5871 and Q5881-Q5891 are connected as paraphase amplifiers. The output of each amplifier is applied to a peak detector.

Peak Detector. The peak detector circuit consists of CR5878, CR5877, CR5887, and CR5885. The most negative DC level from the Quad Phase Rectifier circuit is detected and applied to the DC Buffer Amplifier.

DC Buffer Amplifier. Emitter follower Q5981 acts as a buffer and provides the necessary drive for the AGC Comparator and Burst Present Detector circuits. The output of the buffer is filtered by R5877 and C5775 to ensure an average DC level control voltage to the above circuits. The filter has an approximate bandpass of 5 Hz, which causes noise that appears at this point to be common mode to both sides of comparator Q5781-Q5771.

AGC Comparator. Q5781 and Q5771 are connected as a differential comparator with the base of Q5771 referenced to a fixed DC level. The AGC comparator is biased by the output level of Q5981 so that Q5771 is switched off, thus no AGC current is available to the AGC amplifier. With Gen Lock, the output from the peak detector drives the AGC comparator so that an AGC current corresponding to the amplitude of the externally applied burst signal, is developed through Q5771. This current is fed back to the Chroma AGC Amplifier and increases or decreases the overall chroma gain. Under normal Gen Lock operation, burst amplitudes of 10 to 40 IRE units switch the comparator and produce an AGC output current.

Burst Present Detector. Q5591 and Q5971 are connected as a Schmitt Trigger circuit. If external burst is present, the output DC level from the buffer (Q5981) steps down and triggers the Schmitt circuit. The differential output of the Schmitt circuit drives the subcarrier reference switch.

Subcarrier Reference Switch. Q5951 and Q5931 form this circuit, which is controlled by the Burst Present Detector. When not gen-locked, both transistors are saturated. This provides a resistive divider consisting of R5920, R5929 (3.58 MHz adj.), and R5910 connected between −15 volts and ground (through both transistors). Control of the 149 internal oscillator frequency depends on the setting of R5929. When Q5951 and Q5931 are reverse-biased by the output of Burst Present Detector, the Subcarrier Reference Switch circuit "floats". Control of the internal master oscillator now depends on the Quad Demodulators output signals that are applied to Error Amplifier Q5941-Q5961.

Error Amplifier and Band Switch. This circuit controls the 149 oscillator frequency during Gen-Lock mode of operation. Q5961 and Q5941 are connected as an integrating operational amplifier with C5862 as the feedback capacitor. R_i for this amplifier consists of R5770 or R5770 shunted by R5772, and the transistor switch Q5761.

The rate of integration of the operational amplifier is changed by switching, the Band Switch, Q5761 on or off. The input resistance (R_i) is low when Q5761 is switched on. This increases the rate and amount that the amplifier output voltage shifts the internal master oscillator. With Q5761 turned off, the rate is relatively slow (R_i high) and the bandwidth shift of the oscillator is narrow, improving the noise immunity of the amplifier. Control of Q5761 is obtained from the Quad Lock Detector circuit.

Quad Lock Detector. The Quad Lock Detector circuit consists of a lock delay circuit (Q5861) and a Schmitt multivibrator circuit (Q5841-Q5831). The output of the multivibrator controls the Band Switch.

During initial Gen Lock, Q5861 is forward-biased by a negative pulse applied via CR5865 from the Burst Present Detector circuit. This discharges C5850, which turns Q5841 on. The output of the detector (collector circuit of Q5831) is therefore a negative gate which switches Q5761 on. When lock occurs, Q5861 is turned off by the quadrature signal from the Demodulator circuit, allowing C5850 to charge towards +15 volts. This delays triggering the Schmitt multivibrator to turn Q5761 off, which ensures lock has occurred.

Q5851 is part of the Reed Switch Drive Circuit as described with diagram 9.

3.58 MHz Oscillator

The 3.58 MHz crystal controlled oscillator generates the subcarrier used by the 149. In the free-running mode, the frequency will be within 25 Hz of 3.579545 MHz. In the locked mode, the frequency will be locked to the incoming program burst. The output is amplitude limited and applied to the Subcarrier Output Amplifier (see discussion of diagram 9) for further processing.

DIAGRAM 6 a & b

The Function Generator is used to generate triangle pulses which correspond to the multiburst frequency or the sine-squared pulse. The triangle pulses are then shaped into sine-waves and amplified, thus forming the multiburst or sine-squared pulse.

Basically, when the 149 Mode Switch is set to MULTIBURST, a multiburst switching circuit is used to enable the Multiburst Rate Control circuitry. Timing pulses for each multiburst packet switches current at the appropriate time, such that a voltage staircase (negative-going) appears at the emitter of Q6262 in the Current Switch stage. This drives Q6266 and Q6164 (I and 2I current source) so that a current is applied into the Integrator via current inverter U6170, producing positive-going ramp.

At a point selected by R6898 in the Triangle Level Detector, Q6786 is turned on to reverse bias CR6182, which turns Q6068 off and Q6162 on. Now, current is pulled from C6382 in the Integrator and the ramp reverses.

Between multiburst packets, a stop control signal via Q6095 turns Q6298 on. Q6392 turns off, and CR6376 is forward-biased. With CR6376 in a forward-biased condition, Q6482 turns on and disables the integrator, keeping the ramp from being produced.

The triangle pulses are then applied to a diode shaper and amplifier for processing.

Triangle Generator

This stage, an integrator (Q6398, Q6494, and C6382), is used to produce the triangle pulses (e.g., positive and negative ramps with the rise and fall time equal). Current through C6382 determines the rate of the ramp, hence, the ramp frequency.

Q6478 provides constant current for the integrator. Q6496 provides constant current for emitter follower Q6593, which is used to drive the diode shaper and Triangle Level Detector.

Triangle Level Detector

Q6786 and Q6877 are the active components of the stage. Q6786 detects the most positive excursion of the triangle pulses, Q6877 the most negative. This permits the circuit to change the direction of the ramp.

Current Switch

Q6262, an emitter follower drives two current source transistors Q6266 and Q6164. Q6266 current (set by R6158) is two times less than Q6164 current (set by R6164). The 2I current via Q6164 is applied to a current switch (Q6068 and Q6162); the I current is applied directly to the current inverter stage.

Current Inverter

U6170 and associated circuitry comprise the stage. Its purpose is to supply the current to the integrator for a positive-going ramp, or (when current via the current switch is available) route one-half the current from Q6164 away from the integrator to change the direction of the ramp.

Rate Control

This stage consists of several current switches consisting of transistors and diodes. (For example, Q6212, CR6019, and CR6118.) Current through each transistor determines the rate at which the ramp rises and falls thus the ramp frequency.

Multiburst Switching

Q6103 and Q6010 are the active components of this enabling stage. The stage enables all current switches so that multiburst will be generated only when the front-panel switch is set to the Multiburst position, or when a multiburst VITS has been programmed.

Stop Level and Stop Control

These two stages control the level at which the triangle generator stops and inhibits the generator during non-multiburst or sine-squared pulse time. Q6482 is turned on to stop the ramp.

Diode Shaper

This stage shapes the triangle pulses from the triangle generator into the required sine-waves for use as multiburst frequencies or as the sine-squared pulse. Q6624 A and B provide equal current to both sides of the shaper; this maintains the symmetry of the sine-waves.

Shaper Amplifier

Q6653B, Q6758, and Q6852 form an operational amplifier that sets the amplitude of the multiburst or sine-squared pulse. Q6653A and Q6858 provide temperature compensation.

Setup

CR6703 and Q6803 form a current switch to provide setup current at the correct time.

MB Pedestal Amplitude

The stage consists of three current switches which provide the current required for the pedestal portion of the multiburst signal.

DIAGRAM 7 a & b

Pulse Generator

This stage, consisting of Q7001 and Q7221, generates a narrow pulse which is shaped by the T or 2T Filter into the T or 2T Pulse, respectively.

Bar Generator

This circuit consists of a current switch to provide sufficient current to produce the 100 IRE Bar signal.

T/2T Filters

The filters are used to form the various signals applied.

Mod Pulse Switch

During modulated sine-squared pulse time, this stage allows the current corresponding to the 20T (or 12.5T) pulse luminance to pass through the Delay stage. During multiburst time, the switch puts a DC current through the Delay stage to prevent multiburst from being passed to the Luminance Amplifier.

Delay

The delay circuit is used to match the delay of the modulator.

Luminance Amplifier

The amplifier sets the amplitude and provides sufficient current for the luminance portion of the signals to drive the 149 FULL FIELD OUTPUTS.

MB Gain

This stage sets the amplitude of the multiburst, either NORMAL or REDUCED, and is front-panel controlled. The output is then applied to the Chrominance Amplifier.

Chrominance Amplifier

The amplifier sets the amplitude and provides sufficient current for the chrominance portion of the signals to drive the 149 FULL FIELD OUTPUTS and VITS Inserter.

Add

This stage combines the luminance portion of the signals from the Luminance Amplifier and the chrominance portion of the signals from the Chrominance Amplifier. This forms the composite test signals available at the FULL FIELD OUTPUTS and VITS Inserter.

Ext VITS Amplifier

This stage amplifies the externally applied VIT signal to the correct level to drive the VITS Inserter.

Variable Gain

This stage sets the amplitude of the signals from the Ext VITS Amplifier.

VITS Level Corrector

This stage samples the back porch of the external VIT signal. If the back porch level is not 0 volts, a correction voltage is developed and applied to the Ext VITS Amplifier to return the level to 0 volts.

DIAGRAM 8

The circuitry on diagram 8 is used to shape and combine all signals requiring modulation before applying them to the modulator for mixing.

VIRS Modulation

Current switch CR8801-Q8703 sets the amplitude of the VIRS modulation current. The current is then applied to the VIRS Filter.

VIRS Filter

The filter shapes the VIRS modulation current, such that the modulation has an approximate risetime of 1 μs.

Burst Amplitude

Current switch CR8603-Q8605 sets the amplitude of burst. The output current is then applied to the −(B-Y) filter for shaping. (Risetime is approximately 375 ns.)

B-Y And R-Y Filters

The ±(B-Y) and ±(R-Y) Filters are identical and consist of an LC Pi network. Each filter limits the bandwidth of its drive signal to approximately 1.5 MHz, which prevents any R-Y or B-Y component from exceeding the 3.58 MHz modulating frequency. These filters are adjusted so that the phase shift through each filter is the same. The electrical characteristics of the filters must be identical, since the composite signal is formed after the filters. Separate handling of the + and − components is required to achieve carrier balance stability.

Field Variable Phase

This stage allows for 360° control range of the modulation on the COMPOSITE, SIN^2 PULSE & BAR or WINDOW signal.

With the FULL FIELD Mode switch set to one of the above listed positions, the following occurs: constant current source Q8927 charges C8901, producing a ramp (at the collector of Q8903) for an entire field. During the vertical interval, Q9803 discharges the ramp.

As the ramp voltage increases, it is applied to two variable capacitance diodes (CR8931 and CR8957). These diodes, in conjunction with L8953, L8591, and C8933, form two resonant filters. This enables the subcarrier, via C8881, to be changed 360° in phase.

The output subcarrier is then applied to an AC-coupled limiter circuit, and depending upon the Field Phase switch, is either passed to the AGC Amplifier or shunted to ground.

AGC Amplifier

This stage consists of Q8739, Q8755, Q8551, and Q8455. The circuitry ensures that the subcarrier applied to T8661 secondary is of constant amplitude and shape, i.e., sine-waves of equal magnitude.

Field Fixed Phase

This stage, consisting of CR8789 and Q8781, is similar to the Field Variable Phase limiting amplifier, but allows the phase of the subcarrier applied to the modulator to be varied only from the front-panel. The output of the limiter is also applied to the AGC Amplifier.

Mod Pulse Modulation

This stage, consisting of Q8003, Q8035, and Q8133, couples the modulated sine-squared pulse current to the modulator. The single-ended input signal is converted to a push-pull (balanced) output to drive the modulator.

90° Quad Switch

L8461, C8351, and C8459 form the stage. Its only purpose is to shift the subcarrier phase 90° to allow modulation in all quadrants.

0-180° Switch

Q8485, Q8483, Q8577, and Q8479 form the stage. This circuit selects the phase of the color bar R-Y component.

Modulator

The modulator consists of U8151 and U8255. Each is a double balanced modulator or mixer. This cancels the two input driving signals and retains the sidebands of the input signals.

Bandpass Filter

The modulator output across T8061 is coupled through the bandpass filter to limit the bandpass of the signal to approximately 0.75 MHz above and below the 3.58 MHz point. L8287 and L8177 adjust the filter to a center frequency of 3.58 MHz. The output of the bandpass filter is then applied to the Chroma Output Amplifier.

DIAGRAM 9 a & b

The circuitry contained on the subcarrier and sync board is used to provide current for the Modulated Pedestal Chrominance signal, VIRS pedestal current, Burst, and Composite Sync. In addition, VIRS detection and Sync Lock detection takes place. The CW SUBCARRIER and COMPOSITE SYNC connector drive circuits are contained on the board.

Sync Generator

One-shot multivibrator U201 is toggled at the line rate to produce the line sync, and toggled at twice the line rate to produce the equalizing and serration pulses.

Sync Lock Detector

This stage is used to sense any difference between the internally generated composite sync (pin 6 of U201) and the reprocessed composite sync (P101-1 via the sync separator). U21B looks for coincidence between these two signals. Any difference will cause Q260, Q250, Q350, Q355, and Q319 to be in that condition which (1) turns on the NONSYNCHRONOUS MODE-NO VITS Lamp, (2) Disables the Quad Demodulator stage (see diagram 5_b), (3) inhibits pins 12 and 13 of the Program VIT Switch (see discussion for diagram $0_{a\ \&\ b}$), (4) inhibits composite sync to the COMPOSITE SYNC OUT connector, and (5) most important, switches the input relay such that PROGRAM LINE IN is shunted to the PROGRAM LINE OUT.

Composite Sync Output Amplifier

CR8 and Q10 form a current switch. When CR8 is reversed biased, current through R7 is diverted through Q10. The relatively high output impedance of Q10 serves as a constant current source to drive the filter (L20, C22, L30, C28, and C30). The filter limits the risetime of the composite sync signal to prevent ringing in transmission lines.

Q40, Q30, and Q55 are the active components of an operational amplifier. R32 is the feedback resistance; the input current is determined by R7. Q50 provides current for reverse-terminating any negative pulse which may appear at the output terminal due to unterminated coaxial cables.

Subcarrier Output Amplifier

Q80 is an emitter follower which serves as a buffer and driver. It isolates the oscillator (see diagram 5_c) from the output. Because Q80 is biased near cutoff, it clips the negative portion of the input signal so that the drive signal to Q90 pulses the collector tank circuit (L94, C94, and C90).

The output of the input stage drives an operational amplifier consisting of Q70, Q60, and Q160. This circuit serves as a distribution amplifier to drive various circuits within the 149, plus the CW SUBCARRIER OUT connector.

Reed Switch

This stage, opens the CW Subcarrier output line in the event burst is lost from the driving source. (See Operating Instructions for exception.)

Comp Sync Amplitude

This stage sets the amplitude of the composite sync signal. Current switch CR456-Q458 diverts current as set by R455 to the output or inhibits the sync current by shunting it through R407.

VIRS Pedestal Amplitude

Q479-CR477, Q478-CR480, and Q469-CR467 operate as current switches. Each combination is switched at the appropriate time such that current is diverted to the output to enable the VIRS pedestal to be generated.

Mod Pedestal Timing

U499 is the active component of this stage, and is used to inhibit or enable the Mod Pedestal Modulator Amplitude stage.

Mod Pedestal Amplitude

This stage consists of three current switches consisting of Q499-CR494, Q498-CR494, and Q489-CR485. Current is switched at the appropriate time to drive the modulator so that the mod pedestal chrominance is available.

VIRS Detection

This stage (consisting of U401, U499, Q360, Q450, Q470, Q460, and Q480) is used to detect whether VIRS is applied to the PROGRAM LINE IN. It detects whether chrominance is on the first portion of a line for the appropriate time required, and that chrominance is not present on the second half of the line.

Pin 6 of U449C goes positive on line 20 between Instants (see Operating Instructions for Characteristic Instants) 6 and 18 for use in detecting chrominance on the first half of the line.

Pin 2 of U449A goes positive on line 20 between Instants 18 and 31 to detect luminance on the last half of the line.

Composite video via P701-7 is applied to Q360, an emitter follower, which drives a filter consisting of L438 and L440. If VIRS is present, chrominance will add to the pulse via pin 6 of U449C to turn Q450 on. This produces an integrated (negative-going) signal to drive a set/reset gate on diagram 4, which is also part of the VIRS detector. If chrominance is not present, Q450 and emitter follower Q470 will not turn on to drive the set/reset gate.

If VIRS is not present, no chrominance will add to the pulse via U449A, hence Q460 and Q480 are inactive.

If a signal other than VIRS is applied to line 20 (assume color bars) chrominance is detected on the first half of the line to set the set/reset gate. Chrominance on the second half turns Q460 and Q480 on, producing a pulse to reset the set/reset gate. The 9 Line Keyout via U449E inhibits any VIRS during the equalizing and serration pulses.

DIAGRAM 10

The Low Voltage Power Supply circuit provides three regulated supplies; +15 volts, +5 volts, and −15 volts. Electronic regulation is used to provide stable, low ripple output voltages. All the supplies are current-limited to prevent instrument damage in the event that a supply is shorted to ground. The primary circuit of the transformer employs voltage and range selector plugs to permit selection of the appropriate line voltage operating range.

Power Input

Power is applied to the primary winding of transformer T9001 via RFI Filter FL9201, the POWER switch S9201, 115-volt line fuse F9201, Voltage Selector S9203, and the Range Selector S9202. The voltage selector plug connects the split primaries of T9001 in parallel for the 115-volt range of operation, or in series for 230-volt operation. A second fuse, F9202, is placed in the 230-volt position to provide the correct protection for 230-volt operation.

The Range Selector plug allows the instrument to regulate properly on higher or lower than normal line voltages. Each half of the primary has taps above and below the 115-volt (230) point. As the selector is moved from LO, M, to HI, more turns are added to the primary winding. Therefore, whether the primary voltage has increased or decreased, the secondary voltage can be maintained at a nearly constant level

$$Es = Ep \times \frac{Ns}{Np}$$

The RFI Filter serves to prevent external RF interference from appearing across T9001 and also prevents signals generated within the 149 from being introduced into the AC line.

−15 V Supply

The −15 volt supply provides the reference voltage for the +5 and +15 volt supplies. The reference for the −15 volt supply is a 9.1 volt zener diode, VR9850.

The output from the secondary winding (pins 6 and 7 of P9850) is rectified by a full-wave rectifier consisting of CR9870, CR9876, CR9874, and CR9872. The rectified voltage is filtered by C9061 and applied through a −15 volt series regulator stage, Q9085, to the load. Series regulator Q9085 and its driver, Q9850, are controlled by a voltage comparator consisting of Q9856 and Q9854 with associated components. C9852 filters any noise generated by −15 volt reference VR9850.

Q9852 and associated components, is an overload protection circuit. During excessive load current, Q9852 (normally off) turns on, which turns Q9850 and Q9085 off, hence the −15 volt supply is disconnected.

+5 and +15 Volt Supplies

Both supplies are similar to the −15 volt supply.

SECTION 4
MAINTENANCE AND CALIBRATION

This section of the manual contains information for use in maintenance and calibration of the 149 as follows:

Maintenance

Preventive Maintenance: Cleaning, lubrication, visual inspection, etc.

Troubleshooting: Aids for isolating trouble to a particular stage, etc.

Corrective Maintenance: Replacement procedures and parts ordering information.

Calibration

Inspection: A list of specifications to be checked when performing an incoming inspection.

Procedure: Step-by-step instructions for returning the 149 to specification.

MAINTENANCE

PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, and lubrication. Preventive maintenance performed on a regular basis may prevent instrument breakdown, and will improve the reliability of this instrument.

Cleaning

General. The 149 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket that prevents efficient heat dissipation. It also provides an electrical conduction path.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dirt accumulated on the outside of the 149 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a solution of water and mild detergent. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Lubrication

The reliability of switches and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (e.g., TEKTRONIX Part No. 006-0172-00) for switch contacts. This lubricant does not affect the electrical characteristics of the switch. To lubricate the switch detent, use a heavier lubricant (e.g., TEKTRONIX Part No. 006-0219-00). Do not overlubricate.

Visual Inspection

The 149 should be inspected occasionally for such defects as broken connections, loose or disconnected pin connectors, improperly seated solid-state devices, damaged circuit boards and heat-damaged components.

The correct procedure for most defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Transistor and Integrated Circuit Checks

Periodic checks of the transistors and integrated circuits (IC's) used in the 149 are not recommended. The best indication of performance is the actual operation of the component in the circuit. Performance of the circuit is thoroughly checked when performing either the perform-

ance check or calibration procedure. Any substandard transistors or integrated circuits will usually be detected at that time.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the 149. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles.

Troubleshooting Aids

Diagrams. Circuit diagrams are provided on foldout pages at the rear of this manual. Each component, its electrical value and circuit number are shown on the diagrams. In addition, typical voltages which can be expected are also shown.

Each diagram has been assigned a diagram number and name. For example, the first diagram has been assigned the number 0_a and is called PROGRAM LINE AMPLIFIER. (Other circuitry exists on this diagram but, since the program line amplifier is of prime importance, it was so called.) Notice the solid blue line that surrounds most of the circuitry on this diagram. This line is used to identify a particular circuit board on which the components are physically located. This reference allows for correlation between the diagrams, circuit boards, and electrical parts list. All other components on the circuit board will be found on diagram 0_b.

Table 4-1 lists the various reference diagrams, circuit boards, and electrical numbers used in the 149. All components located outside the blue line are chassis mounted components and have circuit numbers from 9000 to 9499.

Circuit Boards. Fig. 4-1 shows the location of each circuit board within the instrument. Each circuit board is shown (full view) opposite the appropriate diagram in the diagram section. Each electrical component on the board is identified by its circuit number. In most cases, these circuit numbers were assigned on a grid system as a convenience to the user of the instrument. For example, notice the circuit board photo opposite diagram 0_a. The upper left hand corner of this board has been assigned numbers around 500. Proceeding left to right, the numbers go towards 900 at the upper right hand corner. From top to bottom, the numbers increase to 590 at the bottom left corner and 991 at the bottom right corner. Using this method, the physical location of each component is readily available.

TABLE 4-1

Diagram	Function or Circuit Board Name	Circuit Numbers
9	Sub & Sync	0-499
$0_{a\&b}$	VIT Insertion	500-999
1	Vert Counter	1000-1999
$2_{a\&b}$	Horiz Timing	2000-2999
$3_{a\&b}$	APL Color Bar	3000-3999
4	VIT & FF	4000-4999
$5_{a,b,\&c}$	Genlock	5000-5999
$6_{a\&b}$	Function Gen	6000-6999
$7_{a\&b}$	Output Amplifier	7000-7999
8	Modulator	8000-8999
11	Switching & Chassis	9000-9499
10	Power Supply	9500-9999

Waveforms. Important waveforms (typical) are given opposite the appropriate diagram in the diagram section. These waveforms aid in determining if a circuit is functioning properly.

Wire Color Codes. All insulated wires in the 149 are color coded to facilitate circuit tracing. Table 4-2 summarizes the coding system used in the 149.

TABLE 4-2

Color Code	Significance
Black	Chassis Ground
White on Black	Floating Ground
Yellow on Green	Safety Ground
Brown[1]	Filament and Heaters
Gray[1]	AC Line
White[1]	Signal
Red[2]	B+
Violet[2]	B–

Resistor Color Code. In addition to the brown composition resistors, metal film resistors (identified by their gray or light blue color) are used in the 149. The resistance values of composition and metal film resistors are color-coded on the components with the standard EIA color code.

[1] Color Stripes are used on these wires as an aid to circuit tracing.

[2] Color Stripe on wire indicates position of supply with respect to 0 volts (e.g., a black stripe on a red wire would be the first voltage in the positive direction). If a second stripe is used (white only), this indicates a non-regulated supply.

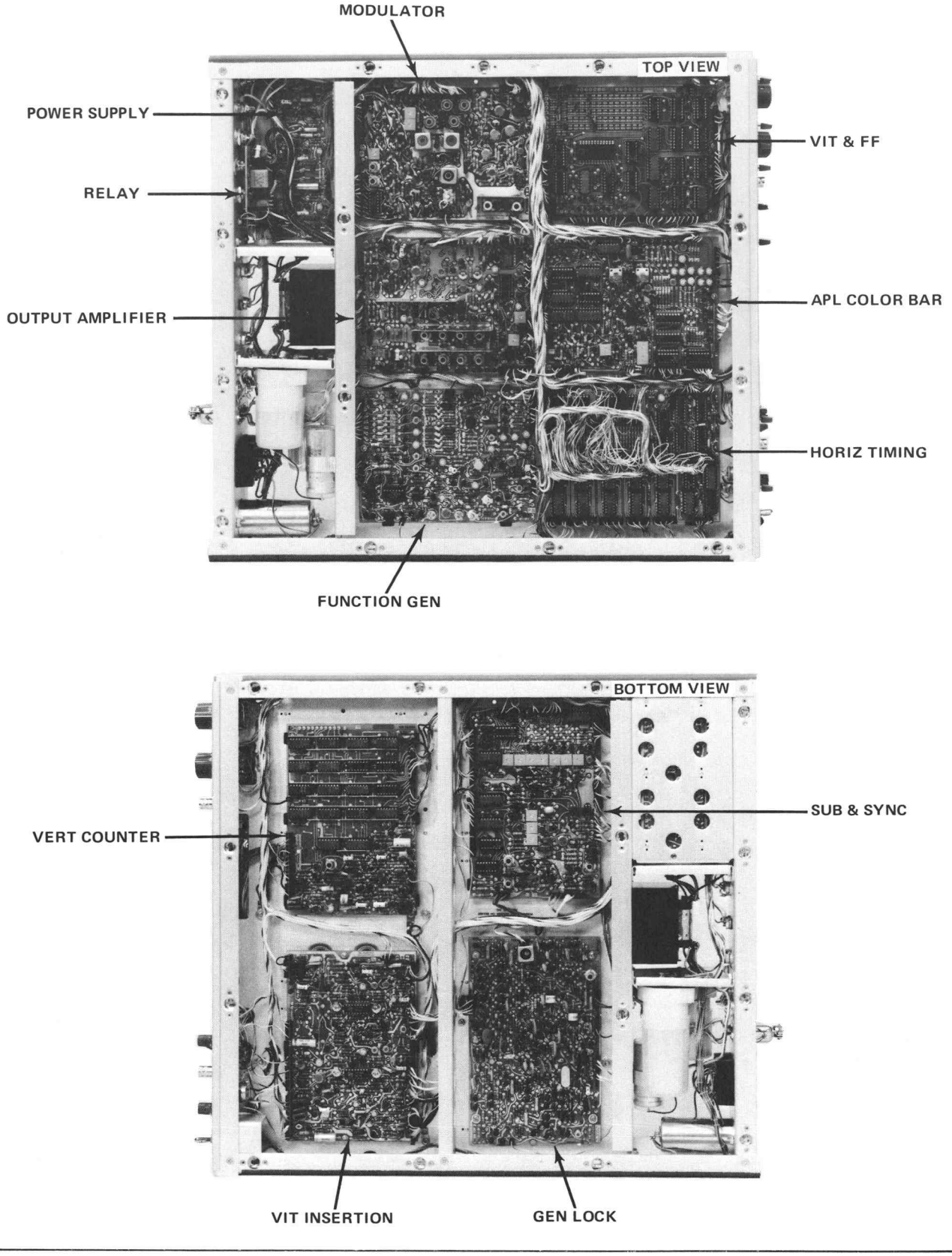


Fig. 4-1. Location of circuit boards in the 149.

Capacitor Markings. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the 149 are color-coded in picofarads using a modified EIA code. The new "tear drop" capacitors are color-coded in microfarads using a modified EIA code, with the dot indicating both temperature and the negative (—) side.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple possibilities before proceeding with extensive troubleshooting.

1. Check Control Settings. Incorrect control settings can indicated trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions.

2. Check Operation of Associated Equipment. Many times malfunction of equipment can be traced to associated equipment.

3. Visual Check. Visually inspect the portion of the instrument in which the trouble is located. Look for unsoldered connections, loose pin connectors, broken wires, damaged circuit boards, damaged components, etc.

4. Check Circuit or Instrument Calibration. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in this section.

5. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptoms. The symptoms often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. A defective component elsewhere in the circuit can also appear as a power supply trouble, and affect the operation of other circuits.

The Circuit Description section of this manual can be used as a guide for isolating a trouble. This description explains how the various signal components are combined to form the video signal. By using the front-panel controls and checking the signals at the BNC connectors, it is possible to determine circuits that are functioning properly and those that are not.

When a trouble is isolated to the smallest possible area, proceed with steps 6 through 8 in this troubleshooting procedure to locate the defective component(s).

6. Check Circuit Board Interconnections. After the trouble has been isolated to a particular area or circuit, check the pin connectors on the circuit board for correct connection.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated by disconnecting the power distribution pin connectors for the voltage at the Power Supply board when making resistance to ground checks.

7. Check Voltage and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given in the Diagrams section.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the back side of the Diagrams Title page.

CAUTION

Due to the component destiny on the circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients which may destroy many components.

WARNING

"Ground lugs" are not always at ground potential. Check the diagrams before using such connections as a ground for the voltmeter test prod or oscilloscope probe. Some transistor cases may be elevated.

8. Check Individual Components. The following procedures describe methods of checking components in the 149. Components which are soldered in place should be checked without removal, by isolating the component if circuit conditions allow. If component isolation is questionable unsolder one end.

a. Transistors (excluding FETS, Field Effect Transistors). The best check of transistor operation is actual

performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new transistor. However, be sure that circuit conditions are not such that a replacement might also be damaged. If substitute transistors are not available, use a dynamic tester such as the TEKTRONIX Type 576.

b. Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals.

CAUTION

Do not use an ohmmeter range that has a high internal current. High current may damage the diodes.

9. Repair and Readjust the Circuit. If any defective component or part is located, follow the replacement procedure given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in this instrument are described here.

Obtaining Replacement Parts

All electrical and mechanical replacement parts for the 149 can be obtained through your local TEKTRONIX Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance, and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies.

Multiple Terminal Connector Holders. Most inter-circuit connections between the circuit boards, or between the boards and chassis mounted components, are made through pin connectors. The terminals in the connector holder are identified with numbers. Connector orientation to the circuit board is keyed with triangles, one on the holder and one on the circuit board. See Fig. 4-2.

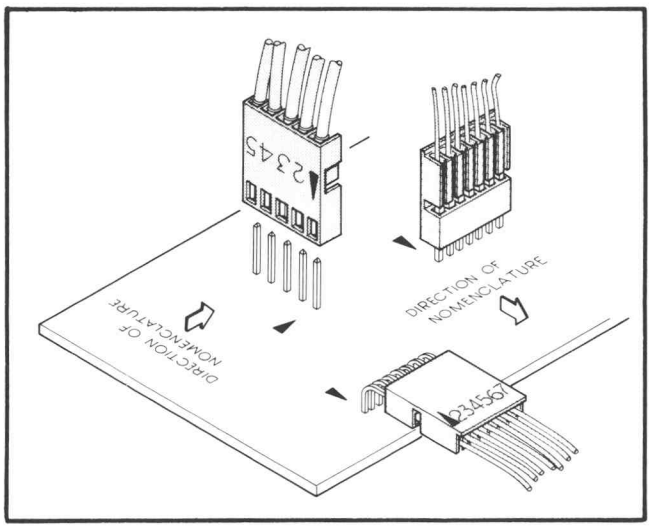


Fig. 4-2. Multipin circuit board connectors.

Circuit Boards. If the circuit board is damaged beyond repair, the entire assembly including all soldered-on components can be replaced.

Transistor and Integrated Circuit Replacement. Transistors and integrated circuits, (IC's) should not be replaced unless they are actually defective. Replacement or exchange of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as on the component being replaced. See Fig. 4-3 for basing diagrams.

The chassis-mounted power supply transistors and their mounting bolts are insulated from the chassis. In addition, silicone grease is used to increase heat transfer capabilities. Re-install the insulators and replace the silicone grease when replacing these transistors. The grease should be applied to both sides of the mica insulators, and should be applied to the bottom side of the transistor where it comes in contact with the insulator.

WARNING

Voltages are present on the exterior surface of the chassis-mounted power supply transistors if the power is applied to the instrument and the POWER switch is on.

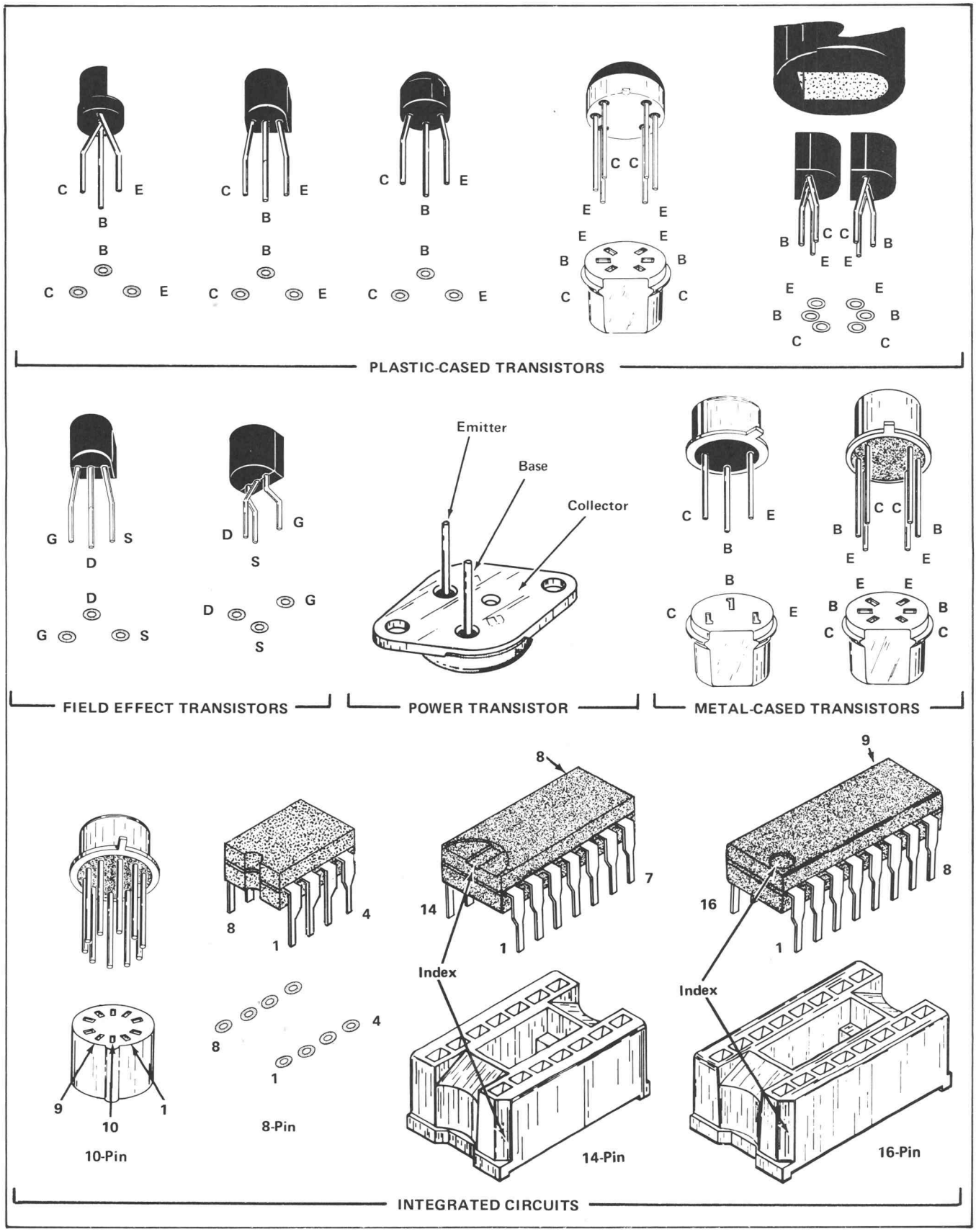


Fig. 4-3. Transistor and Integrated Circuit basing diagrams.

After any component is replaced, check the operation and calibration of the associated circuits.

Indicator Lamp Replacement. To remove the POWER ON indicator lamp, remove the top dust cover from the instrument, then reach behind the front-panel and unplug the lamp from its socket. To replace the lamp, reverse the procedure.

The NONSYNCHRONOUS MODE-NO VITS, PROGRAM, PREVIEW, VIRS INCOMING, VIRS INSERT, and VIRS DELETE indicators consist of two parts; a lens that is attached to the instrument, and a lens cap (connected to the back of the lens) into which the lamps have been soldered. To remove the lamps, reach behind the front-panel, grasp the lens cap and pull straight away from the front-panel. The lens cap will unsnap from the lens, allowing lamp access. Unsolder the lamp. To replace, solder the new lamp into the lens cap. Then place the lens cap on the back of the lens and apply enough pressure to snap the cap into place over the lens.

Fuse Replacement. Both line fuses are contained in plastic holders in the cover for the Line Voltage Selector Assembly at the rear of the instrument. Use only the correct value replacement fuse. Only the upper fuse within the assembly (3/4 A) is used for 115-volt operation. However, for 230-volt operation both the upper and lower fuse (1/2 A) must be installed.

Switches. If a switch is defective, replace the entire assembly. Replacement switches can be ordered by referring to the Parts List for the applicable part numbers.

Power Transformer Replacement. Replace only with a direct replacement TEKTRONIX transformer.

Power Input Connector and RFI Filter Replacement. The Power Input Connector and RFI Filter is replaceable as a unit and repair should not be attempted. If replacement is necessary, observe proper polarity to assure instrument protection.

The narrow blade (terminal number 4) should show continuity to terminal number 3, which connects to fuse F9201, see diagram 10. (The filter contains an internal non-replaceable fuse between these two terminals.) Use care when soldering to terminals numbers 1 and 3, as excess solder could possibly short the filter case.

CALIBRATION

This portion of the manual contains the adjustment sequence for calibrating the 149 to the performance requirements listed in the Specification Section. Limits, tolerances, and waveforms in this procedure are given as calibration guides and are not instrument specifications, unless given in the Specification Section.

The Inspection Procedure is provided so that those familiar with the long-form calibration can check instrument specification without following the step-by-step procedure. Those unfamiliar with the 149 should follow the complete calibration procedure, omitting all adjustments, to check instrument performance.

INSPECTION PROCEDURE

			Group	Step
1. CW SUBCARRIER OUT				
Output	2 V	1.8 to 2.2 V	1	5
2. COMPOSITE SYNC OUT				
Aberrations		4 div display ≤4% (0.16 div)	1	6
Amplitude	4 to 5 V			
3. FULL FIELD SIGNAL LUMINANCE				
a. FLAT FIELD, 100% APL	100 IRE within 1 IRE	717.5 mV (710.2 to 724.7)	2	1
sync	40 IRE within 1 IRE	−286.8 mV (−279.6 to −293.8)	2	2
Blanking level (DC)	0 IRE	0 V ±50 mV	2	3

			Group	Step
FLAT FIELD, 100% APL—100 IRE within 1 IRE		717.5 mV (710.2 to 724.7)	2	4
FIELD SQUARE WAVE	100 IRE within 2 IRE	717.5 mV (702.9 to 732.0)	2	4b
MB PED	100 IRE within 1 IRE	717.5 mV (710.2 to 724.7)	7	1a
COLOR BAR PED	100 IRE within 1 IRE	717.5 mV	7	1a
SIN^2 P & B	100 IRE within 1 IRE	717.5 mV	7	1a
LINEARITY—Ramp	90 IRE within 1 IRE	646.1 mV	7	1a
10 STEP	90 IRE within 1 IRE	646.1 mV	7	1a
5 STEP	80 IRE within 1 IRE	574.2 mV (567.1 to 581.2)	7	1a
BOUNCE 90 IRE	90 IRE ±2 IRE	646.1 mV (631.6 to 660.4)	2	5a
10 IRE	10 IRE ±2 IRE	71.6 mV (64.5 to 78.7)	2	5a
VIRS 7.5 IRE	within 0.5 IRE	53.7 mV (50.1 to 57.2)	7	1b
50 IRE	within 0.5 IRE	358.8 mV (355.2 to 362.3)	7	1b
70 IRE	within 0.5 IRE	502.0 mV (497.0 to 507.1)	7	1b
b. COLOR BARS (Luminance)				
Black		52.7 mV (53.2 to 54.2)	3	14a
Blue		108.3 mV (107.3 to 109.4)	3	14a
Red		202.8 mV (200.8 to 204.8)	4	14a
Magenta		257.7 mV (255.2 to 260.3)	3	14a
Green		347.4 mV (344.0 to 350.9)	3	14a
Cyan		401.9 mV (397.9 to 405.5)	3	14a
Yellow		496.6 mV (491.8 to 724.7)	3	14a
50 IRE PEDESTAL	within 0.5 IRE	358.8 mV (355.2 to 362.3)	3	13
c. MULTIBURST Ampl				
Normal	90 IRE within 1 IRE	646.1 mV (638.9 to 653.2)	5	2a, e; 4a
Reduced	60 IRE within 1 IRE	430.6 mV (423.4 to 437.7)	5	4b
average level				
Normal	55 IRE within 1 IRE	394.4 mV (387.4 to 401.5)	5	7a
Reduced	40 IRE within 1 IRE	286.8 mV (279.6 to 293.8)	5	7b
4. MODULATOR AND CHROMINANCE				
a. Mod Bal, all FULL FIELD signals		≤2.5 mV of 3.58 MHz	3	2a
b. Residual Subcarrier, white level		≤2.5 mV	3	7b
black level		≤2.5 mV	3	7a
c. Yellow Chroma Packet Risetime		375 ns (323 to 431)	3	18a
d. Split Field starts with luminance			3	15
e. COLOR BARS, (Total Chroma)				
blue, yellow		222.3 mV (209.9 to 236.8)	3	8a
red, cyan		312.1 mV (295.5 to 333.2)	3	8a
green, magenta		295.2 mV (277.6 to 313.4)	3	8a
f. MODULATED PEDESTAL				
20 IRE	within 1%	71.61 mV (70.89 to 72.32)	3	12
40 IRE	within 1%	143.32 mV (142.61 to 144.03)	3	12
80 IRE	within 1%	286.76 mV (286.05 to 287.47)	3	12
g. VIRS, BURST & LINEARITY				
VIRS	40 IRE within 0.4 IRE	143.3 mV (140.4 to 146.2)	9	1b
BURST	40 IRE within 0.5 IRE	143.3 mV (139.7 to 146.9)	9	2
LIN	40 IRE within 0.5 IRE	143.3 mV (139.7 to 146.9)	9	3a

		Group	Step
5. RISETIME			
a. Burst Envelope	323 to 431 ns	9	4a
b. VIRS Envelope	0.85 to 1.15 μs	9	4b
c. 2T filter	213 to 287 ns	8	4b
6. FULL FIELD SIGNAL TIMING			
Identical to Fig. 1-2		2	6
7. MULTIBURST			
a. Frequency accuracy			
500 kHz	2 ~ in 8 div ±0.24 div at 0.5 μs/div	5	3a
1.25 MHz	2 ~ in 8 div ±0.24 div at 0.2 μs/div	5	3a
2 MHz	4 ~ in 10 div ±0.3 div at 0.2μs/div	5	3a
3 MHz	3 ~ in 10 div ±0.3 div at 0.1 μs/div	5	3a
3.58 MHz	3 ~ in 8.13 to 8.63 div at 0.1 μs/div	5	3a
4.1 MHz	3 ~ in 7.17 to 7.46 div at 0.1 μs/div	5	3a
b. MB Length			
4 cycles of 500 kHz and all frequencies ending with whole cycles		5	3b
c. MB Center			
0 V average DC level on vectorscope Y display		5	5a
d. MB Flatness: 90 IRE & 60 IRE		5	2h, 4c
Top, ±1.0 IRE; bottom, ±1.0 IRE		5	2h, 4c
8. SIN² PULSE & BAR			
a. Modulated 12.5T pulse: HAD 1.75 μs (1.49 to 1.64 μs)		8	2
b. 12.5T pulse to bar ratio: 100% ±0.5%		8	2
c. 12.5T pulse baseline ripple, any line: ≤0.6 IRE		6	2
d. 12.5T modulation vector: even display with no bunching and ending at magenta		6	2
e. 2T pulse to bar ratio: 0.25%		8	1a
f. 2T pulse HAD: 250 ns (243 to 257 μs) amplitude: within 0.25% of bar amplitude ringing ringing: ≤ 0.5 IRE		8	1a
9. LINEARITY			
a. 10 STEP: equal in amplitude, within 1%		16	b
5 STEP: equal in amplitude, within 1%		16	b
b. Diff Gain: ≤0.5%, diff phase: ≤ 0.2°		10	a, b
10. HARMONICS			
All FULL FIELD signal harmonics ≥ 40 dB down from the reference signal.		5 8 5	2, 3, 4 3
11. BOUNCE			
Bounce: about 1 s to 10 s or more		2	5
12. VIT ADDER-DIFF PHASE & GAIN			
a. PROGRAM LINE OUT: diff phase, ≤0.15°; diff gain, ≤ 0.2%		13	1b, 1c
b. PREVIEW MONITOR OUT: diff phase, ≤ 0.3°; diff gain, ≤ 0.4%		13	2

13. VITS INSERTION	Group	Step
a. PROGRAM LINE OUT		
Gain change between PROGRAM, PREVIEW, & AUXILIARY:		9c, d
Unity gain ±1%, all signals	14	2c, 6f
DC Level: within 50 mV of AUXILIARY level	14	2b
FULL FIELD MULTIBURST flatness: within 1% of FF TEST SIGNAL	14	4b
MULTIBURST VITS flatness: within 1% of FF TEST SIGNAL	14	4b, 6f
b. PREVIEW MONITOR OUT		
Gain, PROGRAM LINE OUT to PREVIEW MONITOR OUT:		
Unity gain ±1%	14	3c
DC Level: within 50 mV of AUXILIARY level & PROGRAM LINE OUT	14	3b
PREVIEW VITS Flatness: within 1% of FF TEST SIGNAL	14	4a, 8
PREVIEW Flatness: within 1% of FF TEST SIGNAL	14	4a, 8
Other PREVIEW MONITOR	14	3e
c. INSERT SUBCARRIER PHASE		
$\geqslant 5^{\circ}$ either side of burst	14	5a, 7a
Set for no error, PROGRAM	14	5b, 7c
No error, PREVIEW	14	5b, 7d
d. Unwanted VITS Pedestal		
PROGRAM & PREVIEW: $\leqslant$ 5 mV	14	2b
e. Amplitude Ratio, PROGRAM		
2T pulse to bar: 100% ±0.25% (1.8 mV)	14	2e, 6f
12.5T pulse to bar: 100% ±0.5% (3.5 mV)	14	2e, 6f
12.5T luminance to chrominance change: $\leqslant$ 0.5%	14	2e, 6f
f. Waveform Tilt, PROGRAM & PREVIEW		
25 μs bar: $\leqslant$ 0.5%	14	10b, c
FIELD (rate) SQ WAVE: $\leqslant$ 0.5%	14	10e, f
14. AUXILIARY PEDESTAL & UNITY GAIN-VAR LEVEL		
a. AUXILIARY PEDESTAL		
$\geqslant$ –10 IRE to $\geqslant$ 90 IRE	14	11a
b. UNITY GAIN-VAR GAIN		
$\leqslant$ 70 IRE to $\geqslant$ 130 IRE, PROGRAM & PREVIEW	14	12
15. Verify FRONT PANEL PROGRAMMING		
VITS and VIRS agree with front panel.	13	3a
16. PROGRAM LINE OUT-ABERRATIONS		
a. Residual subcarrier –60 dB ($\leqslant$ 0.7 mV)	16	7a
b. Inactive part of lines –40 dB ($\leqslant$ 7 mV)	16	7b
c. Active part of lines	16	7c
Spurious –60 dB ($\leqslant$ 0.7 mV)		
FF 2T pulse –60 dB ($\leqslant$ 0.7 mV)		
FF Subcarrier (staircase): –60 dB ($\leqslant$ 0.7 mV)		
All other FF signals –60 dB ($\leqslant$ 0.7 mV)		

	Group	Step
d. Delete mode 2T: –70 dB (≤ 0.22 mV) Subcarrier (Color Bars): –60 dB (≤ 0.7 mV) Any int signal (rotate FF switch –60 dB (≤ 0.7 mV)	16	7d
e. Non-inserted lines Hum & power line transients 60 dB (≤ 0.7 mV)	16	73
f. Random Noise –75 dB (0.14 mV or less)	16	7f

17. INSERT DELAY & TIMING

a. Delay: start of sync to start of NOISE or MB VITS. ≤ 9.3 to ≥ 10.7 μs with INSERT DELAY adjustment		15	1a
b. INSERT DELAY range: 1.0 μs or more			
c. Serration width	4.3 to 4.7 μs	15	2
Sync width	4.65 to 4.75 μs		
Equalizer width	2.28 to 2.38 μs		

18. RETURN LOSS

a. Return Loss - At least –30 dB (≤ 7.9 mV) from 50 kHz to 6 MHz		16	3
b. Turn power on, check return loss.			
PROGRAM LINE IN	–30 dB to 6 MHz		
PROGRAM LINE OUT	–30 dB to 5 MHz		
PREVIEW MONITOR (both)	–30 dB to 5 MHz		
COMP SYNC	–30 dB to 3.6 MHz		
FULL FIELD OUT (both)	–30 dB to 5 MHz		
AUX IN	–30 dB to 5 MHz		
EXT VIT INPUT	–34 dB to 5 MHz (5 mV)		

19. SYNC & GEN LOCK — 12

Display the vertical interval of the 149 full-field signal.

Set the PROGRAM CONTROL switch to AUXILIARY to bypass the 149 from the PROGRAM LINE.

Set the SYNC SOURCE switch (rear-panel) to BLACK BURST. The NONSYNCHRONOUS MODE-NO VITS light should be on. There should be no VITS and no VIRS.

Connect the composite sync signal to the BLACK BURST input. The NON-SYNC lamp should extinguish. There should be VITS but no VIRS.

Replace the composite sync signal with a composite video signal (with sync and subcarrier). There should be VITS and VIRS and no signal lights on.

Set the SYNC SOURCE switch to PROGRAM LINE. Check that signals lights are on and VITS & VIRS are present.

CALIBRATION PROCEDURE

General

The calibration procedure is arranged in a sequence designed for calibration with minimum interaction of adjustments and reconnection of equipment. However, some adjustments affect the calibration of other circuits, and it may be necessary to check the operation of other parts of the instrument. Where adjustments interact, they are noted.

The procedure uses the equipment and fixtures listed in the Test Equipment Used list. If substitute or alternate test equipment is used, control setting or test equipment setup may need to be altered to meet the requirements of the equipment used.

The 149 front- and rear-panel control titles and signal output connectors are capitalized (e.g., COMP SYNC). Internal adjustment titles are initial capitalized only (e.g., VIRS Mod Ampl).

All waveforms shown in the procedure are actual photographs taken with a TEKTRONIX Oscilloscope Projected-Graticule Camera System.

Test Equipment Used

All test equipment is assumed to be correctly calibrated and operating within the given specification. Correct operation of all test equipment is also assumed.

Test Equipment for Adjustment Steps

1. Waveform Monitor. TEKTRONIX Type 529 Waveform Monitor (monitor).

2. Vectorscope. TEKTRONIX Type 520A NTSC Vectorscope (vectorscope).

3. Test Oscilloscope. Bandwidth, DC to at least 30 MHz; minimum deflection factor, 1 mV/division; two input channels, capable of independent or differential operation; time base, at least 0.1 μs/division and slower. TEKTRONIX Type 547 Oscilloscope with Type 1A5 Plug-In Unit (test oscilloscope).

4. Video Signal Source. Signals: NTSC color bars (100% white reference, 75% amplitude and 7.5% setup), or modulated staircase (5 steps and 20 IRE subcarrier) and VITS insertion; composite sync and subcarrier. TEKTRONIX Type 140 NTSC Test Signal Generator.

5. DC Voltmeter. Capable of measuring 5 and 15 volts within 1%.

6. Chopped Voltage Reference. TEKTRONIX Calibration Fixture 067-0596-00 (chopper).

NOTE

See the 067-0596-00 Calibration Fixture instruction manual for details on obtaining a chopped signal. All chopper dial readings include a correction factor. Make final checks and adjustments with a deflection factor of 10 mV/Div.

7. Coaxial Cable (7). 75 Ω with BNC connectors (cable). TEKTRONIX Part No. 012-0074-00.

8. Termination (3). 75 Ω end-line, with BNC connectors (end-line termination). TEKTRONIX Part No. 011-0103-02.

9. Termination (2). 75 Ω feed-through with BNC connectors (feed-through termination). TEKTRONIX Part No. 011-0103-02.

Test Equipment for Optional Checks

10. Variable Autotransformer. Power Supply regulation, see Calibration Procedure Group 16, Step 1. Capable of supplying at least 200 volt-amperes over the desired line voltage range. General Radio W10MT3W Metered Variac Autotransformer.

11. Spectrum Analyzer. Harmonics, see Calibration Procedure Group 3, Step 5; Group 5, Steps 2, 3, and 4; Group 8, Step 3; and Group 16, Step 5. Center frequency 0.1 MHz; Resolution, 100 kHz; Frequency span, at least 2 MHz/division. RF attenuation range, capable of measuring 40 dB below the reference signal. TEKTRONIX 1401A Spectrum Analyzer with a TEKTRONIX 323 Oscilloscope (or the test oscilloscope).

12. RMS Voltmeter. Random noise on the PROGRAM OUTPUT, see Calibration Procedure Group 16, Step 7f. Capable of measuring 75 dB (RMS) down. Hewlett-Packard Model 3400A. Use with: Continuous Random Noise Measurement Low Pass Filter, TEKTRONIX Calibration Fixture 015-0212-00.

13. Filter. PROGRAM LINE OUT aberrations, see Calibration Procedure Group 16, Steps 7b, 7c, 7d, 7e, and

7f. Continuous Random Noise Measurement Low Pass Filter, Fc = 5.0 MHz. TEKTRONIX Calibration Fixture 015-0213-00.

14. Weighting Network. PROGRAM LINE OUT aberrations, see Calibration Procedure Group 16, Step 7e and 7f. Continuous Random Noise Measurement Weighting Network, Fc = 5.0 MHz. TEKTRONIX Calibration Fixture 015-0215-00.

15. Constant Amplitude Signal Generator. Return Loss, see Calibration Procedure Group 16, Step 3. Output of at least 500 mV; frequency range, 50 kHz and variable from 1 MHz to 6 MHz. TEKTRONIX Type 191 Constant Amplitude Signal Generator (signal generator). Use with:

Return Loss Bridge, TEKTRONIX Part No. 015-0149-00

Minimum Loss Attenuator, 50 Ω to 75 Ω. TEKTRONIX Part No. 011-0057-00.

Calibration Aid

Table 4-3 is provided as a cross-reference between the adjustments and calibration procedure steps. If a wrong adjustment is made, this table may be used to locate that step in the procedure where it is properly adjusted. If the above situation exist, read the complete step to check for interaction of other adjustments.

TABLE 4-3

Adjustment	Function of Adjustment (most cases)	Calibration Key	
		Group	Step
C749	Program Chroma Gain	14	6c
C779	Program MB VITS flatness	14	6b, c
C849	Preview flatness	14	7d
C879	Preview MB VITS flatness	14	8
C3470	10-step amplitude	7	1a
C3565	5-step amplitude	7	1a
C6693	MB harmonics	5	3c
C6788	MB harmonics	5	3d
C7461	MB 90 IRE flatness	5	2d, h; 4c
C7463	MB 60 IRE flatness	5	2c, h; 4c
C8677	180° switch phase	3	3b
L20	Comp Sync Filter	1	6
L30	Comp Sync Filter	1	6
L94	Subcarrier amplitude	1	5
L1670	1 MHz Osc.	1	3
L5101	VIRS phase	14	7a
L7301	2T filter	8	1c
L7311	T filter	8	1b
L7401	2T filter	8	1c
L7411	T filter	8	1b
L7501	2T filter	8	1c
L7511	T filter	8	1b
L7601	2T filter	8	1c
L7611	T filter	8	1b
L8177	Bandpass filter	3	5b
L8287	Bandpass filter	3	5b
L8401	−(R-Y) filter	3	1
L8431	−(B-Y) filter	3	1
L8437	VIRS filter	9	4b
L8461	90° Quad Phase	3	4a, 6a
L8501	+(R-Y) filter	3	1
L8531	+(B-Y) filter	3	1

TABLE 4-3 (cont)

Adjustment	Function of Adjustment (most cases)	Calibration Key	
		Group	Step
L8629	VIRS filter	9	4b
L8951	Phase mod filter	6 (8)	2a (2)
L8953	Phase mod filter	6 (8)	2a (2)
R150	Equalizer width	15	2
R250	Sync width	15	2
R350	Serration width	15	2
R450	VIRS Det Sens	11	--
R455	Sync ampl	2	2
R467	VIRS Ped 7.5 IRE	7	1b
R475	VIRS Ped 70 IRE	7	1b
R476	VIRS Ped 50 IRE	7	1b
R484	Mod Ped 80 IRE	3	12
R492	Mod Ped 40 IRE	3	12
R493	Mod Ped 20 IRE	3	12
R505	Program Gain	14	2C
R735	Diff Phase	13	1b
R765	Program Luminance Gain	14	2c, 9c
R775	Program Sync Level	14	2b
R780	Program Bandwidth	14	6b, d
R785	Program DC Level	14	2b
R965	Preview Luminance Gain	14	3c, 9d
R975	Preview Sync Level	14	3b
R985	Preview DC Level	14	3b
R1988	Sync Delay	15	3
R2715	MB Length	5	3b
R3074	Green (R-Y)	6	9b
R3076	Blue (B-Y)	3	2c, 6c, 10c, 10b
R3084	Green (B-Y)	3	10b
R3086	Red (Y)	3	14a
R3174	Red (B-Y)	3	10b
R3176	Red (R-Y)	3	2c, 6, 9c, 9b
R3184	Black (Y)	3	14a
R3186	50 IRE	3	13
R3196	Blue (Y)	3	14a
R3198	Green (Y)	3	14a
R3274	Blue (R-Y)	3	9b
R3284	White (Y)	3 (7)	14a (1a)
R3369	Luminance/Chroma Delay	3	17c
R3410	40 IRE Mod amplitude	9	3a
R3420	20 IRE Mod amplitude	9	3b

TABLE 4-3 (cont)

Adjustment	Function of Adjustment (most cases)	Calibration Key	
		Group	Step
R3616	Ramp amplitude	7	1a
R5929	3.58 MHz Adj.	12	4b
R6202	MB 1.25 MHz	5	3a
R6304	MB 500 kHz	5	3a
R6314	MB 2.0 MHz	5	3a
R6324	MB 3.0 MHz	5	3a
R6334	MB 3.58 MHz	5	3a
R6344	MB 4.1 MHz	5	3a
R6354	Mod Pulse width	4	2b, c
R6362	Mod Pulse symmetry	4	2b, c
R6485	Mod Pulse level	4	1a
R6673	MB centering	5	2b, 5a
R6736	MB Bandpass	5	2b
R6741	MB Gain	5	2a, e; 4a
R6833	MB Pedestal	5 (7)	6 (1a)
R6836	MB Center Level	5	7a
R6898	MB harmonics	5	2a, 3d
R6938	MB Setup level	5	2a
R6942	MB Sync level	5	2a, e; 5b
R6977	MB harmonics	5	2g, 3c
R7131	2T pulse amplitude	8	1c
R7138	T pulse amplitude	8	1b
R7143	Bar amplitude	7	1a
R7357	Luminance gain	8	2
R7361	Auxiliary sync level	14	1
R7453	P & B sync level	6 (8)	1d (2)
R7615	Mod delay	6 (8)	2a (2)
R7661	Modulation gain	3	9b
R7733	DC level	2	3
R7735	Reference Pedestal amplitude	2	1
R7993	Ext VITS gain	16	4
R8007	P & B Mod Ped	3 (6)	2e (1c)
R8109	Sin^2 Chroma Gain	6 (8)	1d (2)
R8229	Flat Field Mod Bal	3	2b, 6b
R8705	Burst Ampl	9	2
R8727	VIRS Mod Ampl	9	1b
R8939	20T Phase	6	2a
R9801	+5 volt Adj.	1	1c
R9831	+15 volt Adj.	1	1b
R9851	−15 volt Adj.	1	1a

Preliminary Procedure

1. Install the rear-panel REMOTE plug P9014. Allow a ten minute warmup at 25°C ±5°C before checking or calibrating the instrument.

2. Set the 149 switches to the up position, except:

REMOTE/LOCAL	LOCAL
SPLIT FIELD/FULL FIELD	FULL FIELD
FULL FIELD SIG	
Mode	FLAT FIELD
APL	VARIABLE
VARIABLE	100
SYNC SOURCE	PROGRAM LINE

3. Connect an external 1-volt peak-to-peak composite video signal to the 149 PROGRAM LINE IN.

NOTE

Unless otherwise noted, connections made to the 149 are via a 75 Ω coaxial cable.

4. From the 149 rear-panel FULL FIELD TEST SIGNAL OUT connector, connect a cable to the monitor input; loop-through, with another cable, to the vectorscope input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

NOTE

Unless otherwise stated, 149 signals to the test oscilloscope are through a cable, terminated with a feed-through termination at the test oscilloscope input.

5. Externally trigger the test oscilloscope with composite sync.

6. Connect the video signal source composite sync signal to the monitor Ext Sync Input; connect the loop-through, with another cable, to the vectorscope Ext Sync Input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

7. Connect the video signal source subcarrier to the vectorscope Ext Φ Ref Input; terminate the vectorscope loop-through with a 75 Ω end-line termination.

NOTE

Preliminary steps 2 through 7 is the basic setup for this procedure. If no setup is given at the start of a step, use this one.

GROUP 1-INITIAL

NOTE

Do not adjust the power supplies if they are within the listed tolerances. Adjustment of any supply will affect the operation of other circuits within the instrument. If a complete recalibration is being performed, set each voltage to the exact setting.

1. Check/Adjust Power Supply Voltage

a. Connect a precision DC Voltmeter between chassis ground (pin 1 of P9834) and P9852 (–15 volts), see Fig. 4-4.

CHECK—Voltage should be –15 volts within 1% (--14.85 to –15.15 V).

ADJUST—R9851 (–15 Volt Adj) for –15 volts.

b. Connect the voltmeter between chassis ground and P9832 (+15 volts).

CHECK—Voltage should be +15 volts within 1% (14.85 to 15.15 V).

ADJUST—R9831 (+15 Volts Adj) for +15 volts.

c. Connect the voltmeter between chassis ground and P9802 (+5 volts).

CHECK—Voltage should be +5 volts within 1% (4.95 to 5.05 V).

ADJUST—R9801 (+5 Volts Adj) for +5 volts.

d. Repeat the above adjustments to remove any interaction.

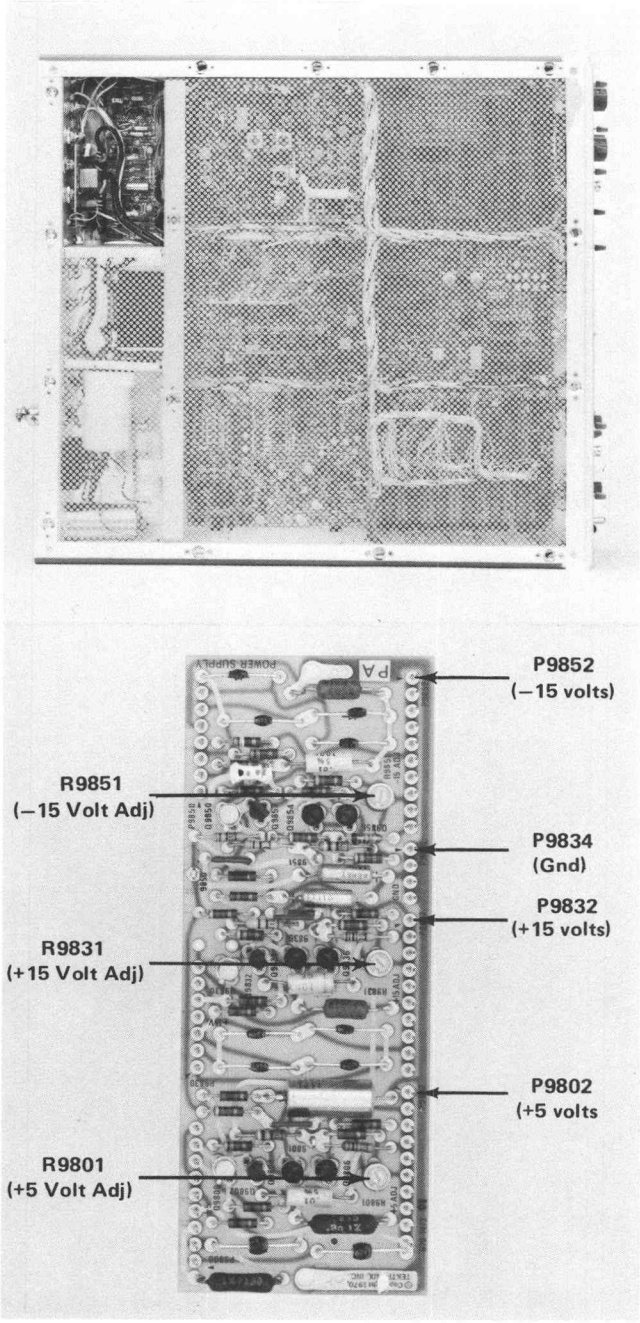


Fig. 4-4. Power Supply test point and adjustment locations.

2. Check Power Supply Ripple

Use a 1X probe, between the supply under test and the test oscilloscope.

CHECK—Power line related ripple at these plugs:

Plug	Supply	Max Ripple
P9852	−15 V	10 mV
P9832	+15 V	10 mV
P9802	+ 5 V	10 mV

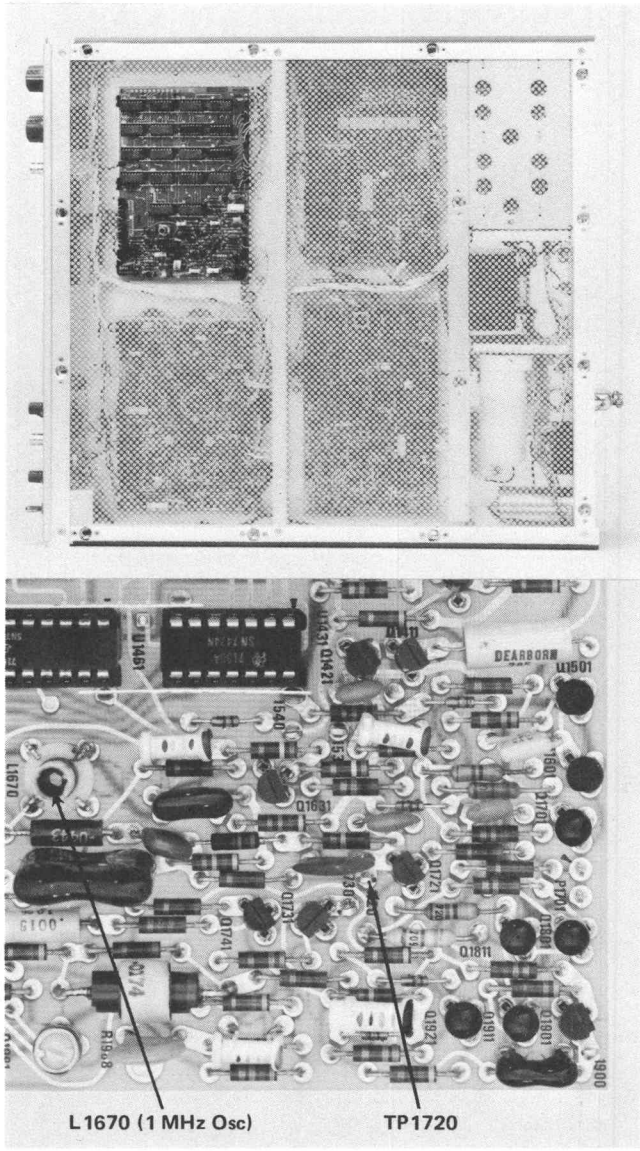


Fig. 4-5. Vertical Counter test point and adjustment locations.

3. Check/Adjust 1 MHz Oscillator Lock

Establish a 0-volt (ground) reference point on the test oscilloscope. Connect a 10X probe to TP1720, see Fig. 4-5.

CHECK—Display DC level should be approximately +2.5 V.

ADJUST—L1670 (1 MHz Osc) to position the display midway between the two levels at which the oscillator free-runs, (one level near +5 V DC and the other near 0 V DC).

4. Check/Adjust INSERT DELAY Range

Connect the 10X probe to the back of the FULL FIELD SIG OUT connector. Display the full-field signal and establish a horizontal timing reference point.

CHECK—Rotation of the INSERT DELAY control, through its range, should move the display 1 μs or more.

ADJUST—INSERT DELAY control to electrical mid-range.

5. Check/Adjust Subcarrier Amplitude

Display the 149 CW SUBCARRIER OUT on the test oscilloscope.

CHECK—Subcarrier amplitude should be between 1.8 and 2.2 volts peak-to-peak.

ADJUST—L94 (Subcarrier Ampl), see Fig. 4-6, for a subcarrier amplitude of 2 volts peak-to-peak.

6. Check/Adjust Composite Sync

Display the 149 COMP SYNC on the test oscilloscope.

CHECK—Composite Sync amplitude should be between 4 and 5 volts peak-to-peak.

CHECK—Aberrations on leading corner of the sync should be 4%, or less, of the total amplitude.

ADJUST—L20 and L30 (Sync Filter), see Fig. 4-6, for the best square corner on the leading edge of sync with aberrations 4% or less.

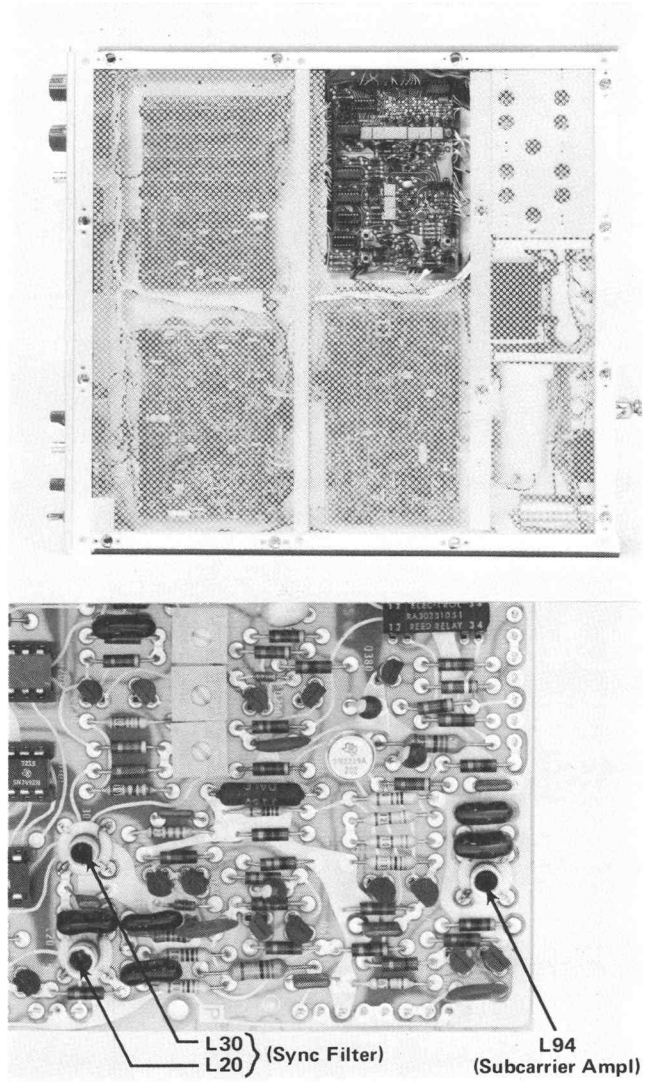


Fig. 4-6. Subcarrier & Sync adjustment locations.

GROUP 2-OUTPUT AMPLITUDES

1. Check/Adjust Pedestal Amplitude

Display the rear-panel FULL FIELD TEST SIGNAL on the test oscilloscope. Connect the chopper to the test oscilloscope and display the chopped signal.

NOTE

See the 067-0596-00 Calibration Fixture instruction manual for details on obtaining a chopped signal. All chopper dial readings include a correction factor. Make final checks and adjustments with a deflection factor of 10 mV/Div.

CHECK—Pedestal amplitude should be between 710.2 and 724.7 mV (100 IRE within 1 IRE).

ADJUST—R7735 (Reference Ampl), see Fig. 4-7, for a pedestal amplitude of 717.5 mV (100 IRE).

2. Check/Adjust Sync Amplitude

CHECK—Sync amplitude should be between −279.6 and −293.8 mV (40 IRE within 1 IRE).

ADJUST—R455 (Sync Ampl), see Fig. 4-8, for a sync amplitude of −286.88 mV (40 IRE).

3. Check/Adjust Output DC Level

a. Set the test oscilloscope to display only the 149 signal. Establish a 0 volt (ground) reference.

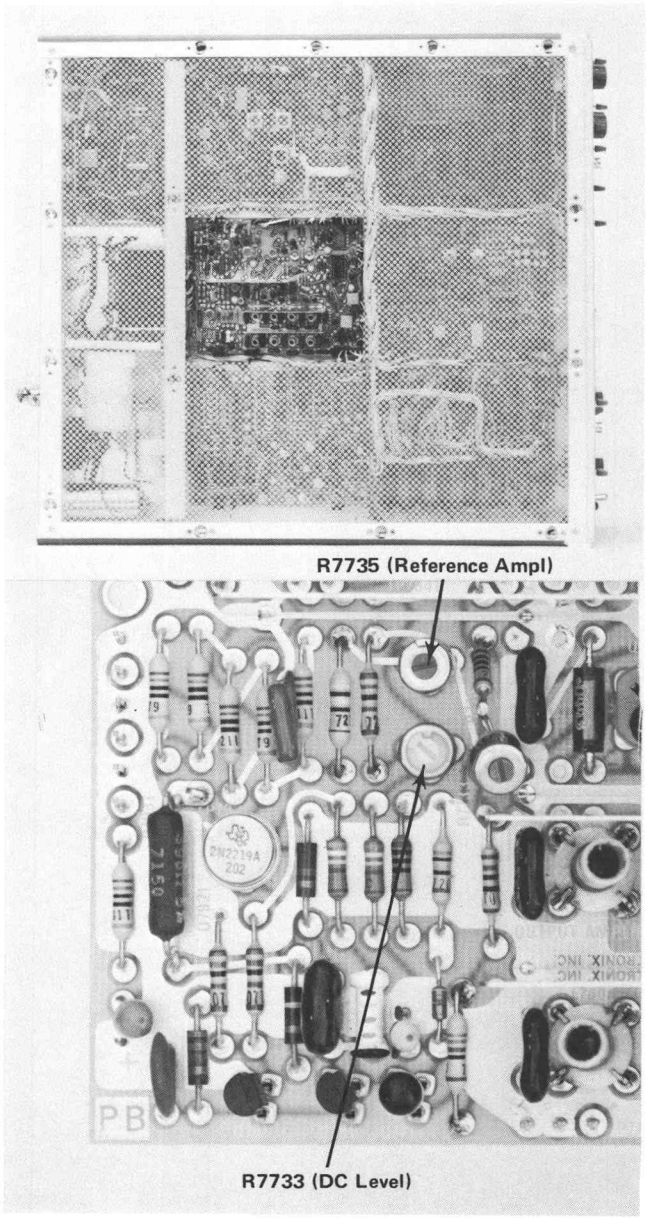


Fig. 4-7. Output Amplifier adjustment locations.

CHECK—Blanking level should be 0 volts within 50 mV.

ADJUST—R7733 (DC Level), see Fig. 4-7, to position the blanking level to 0 volts.

b. Set the test oscilloscope to display the chopped signal.

4. Check FULL FIELD SIGNAL Outputs

a. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope.

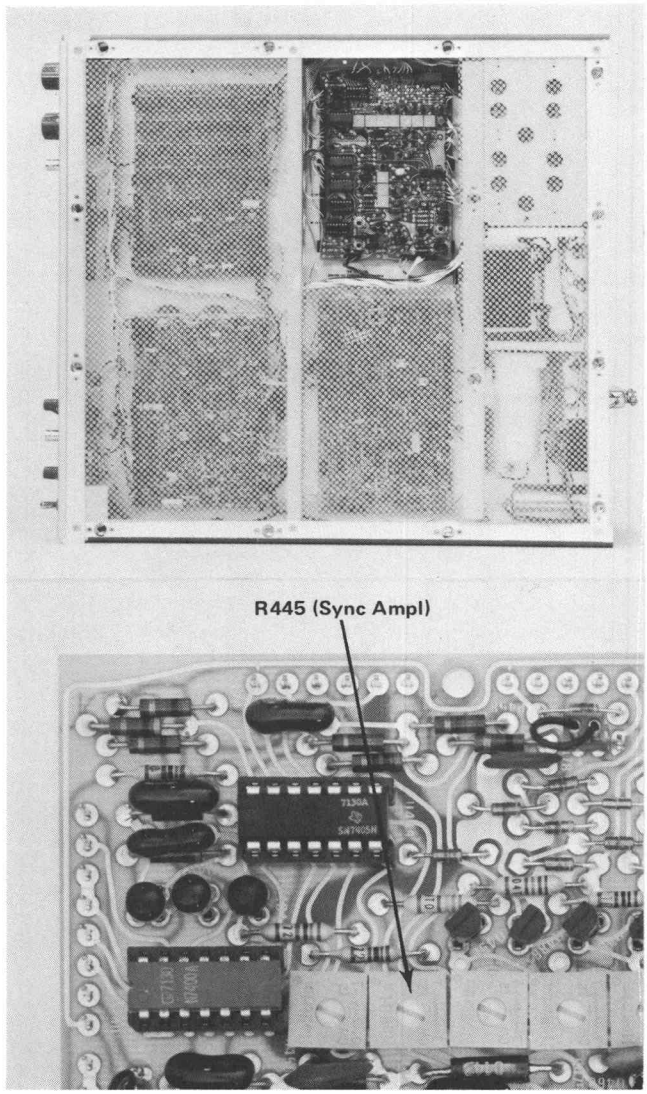


Fig. 4-8. Sub & Sync adjustment location.

CHECK—Pedestal amplitude should be between 710.2 and 724.7 mV (100 IRE within 1 IRE).

b. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope. Set the FULL FIELD SIG switch to FIELD SQ WAVE.

CHECK—Pedestal amplitude should be between 702.9 and 732.0 mV (100 IRE within 2 IRE).

5. Check BOUNCE Amplitude, Rate, and Start

a. Set the 149 FULL FIELD SIG switch to FLAT FIELD, the APL switch to BOUNCE 10-90, and the RATE control to maximum CW.

CHECK—BOUNCE APL changes between two levels:

57.3 and 85.9 mV (10 IRE ±2 IRE)

9631.6 and 660.4 mV (90 IRE ±2 IRE)

b. Connect a 10X probe to the collector of Q3820, see Fig. 4-9. Set the test oscilloscope to view only the signal via the 10X probe using internal triggering. Do not use AUTO triggering.

CHECK—BOUNCE switching should occur once each second or faster.

c. Set the BOUNCE RATE control to maximum CCW.

CHECK—BOUNCE switching should occur once each 10 seconds or slower.

d. Set the BOUNCE RATE control to maximum CW. Externally trigger the test oscilloscope from composite sync.

CHECK—BOUNCE switching occurs approximately 2.2 ms from the start of the signal (line 57).

NOTE

When the connector on P3926 is between pins 1 and 2, switching occurs at random.

6. Check Full-Field Signal Timing

Using Fig. 1-2 of this manual as a guide, check that each full-field signal generated by the 149 has been horizontally programmed as shown.

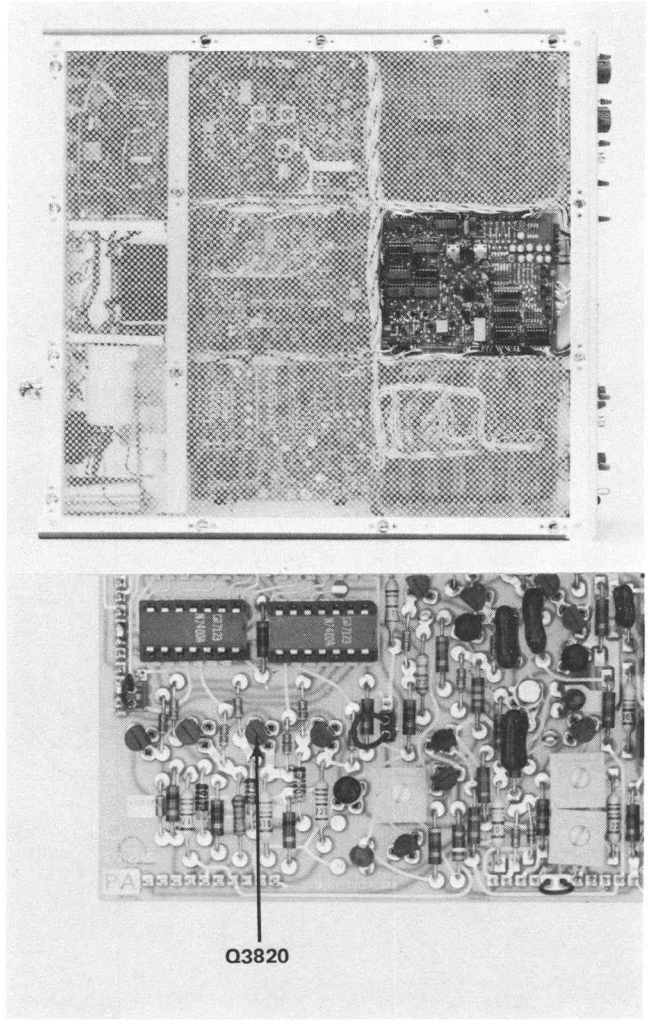


Fig. 4-9. Q3820 location.

GROUP 3-COLOR BARS

1. Check/Adjust Color Difference Filter Response

Set the 149 FULL FIELD SIG switch to COLOR TEST SIGNAL. Use a properly compensated 10X probe between the test oscilloscope and test point under test.

CHECK—Signals at the following test points should have good transient response and similar risetimes, approximately 250 ns: TP8300, TP8309, TP8330, and TP8400 (see Fig. 4-10).

ADJUST—Filters for best transient response and similar risetimes.

L8501	+(R-Y)	TP8300
L8401	−(R-Y)	TP8309
L8531	+(B-Y)	TP8330
L8431	−(B-Y)	TP8400

2. Check/Adjust Modulator Balance

a. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope.

CHECK—Each position of the FULL FIELD SIG switch for a modulation amplitude of 2.5 mV or less on the blanking level. If the modulation on the blanking level is acceptable, go to step 3.

b. Set the FULL FIELD SIG switch to FLAT FIELD.

ADJUST—R8229 and R8135 (Modulator Balance), see Fig. 4-10, for minimum modulation on the blanking level.

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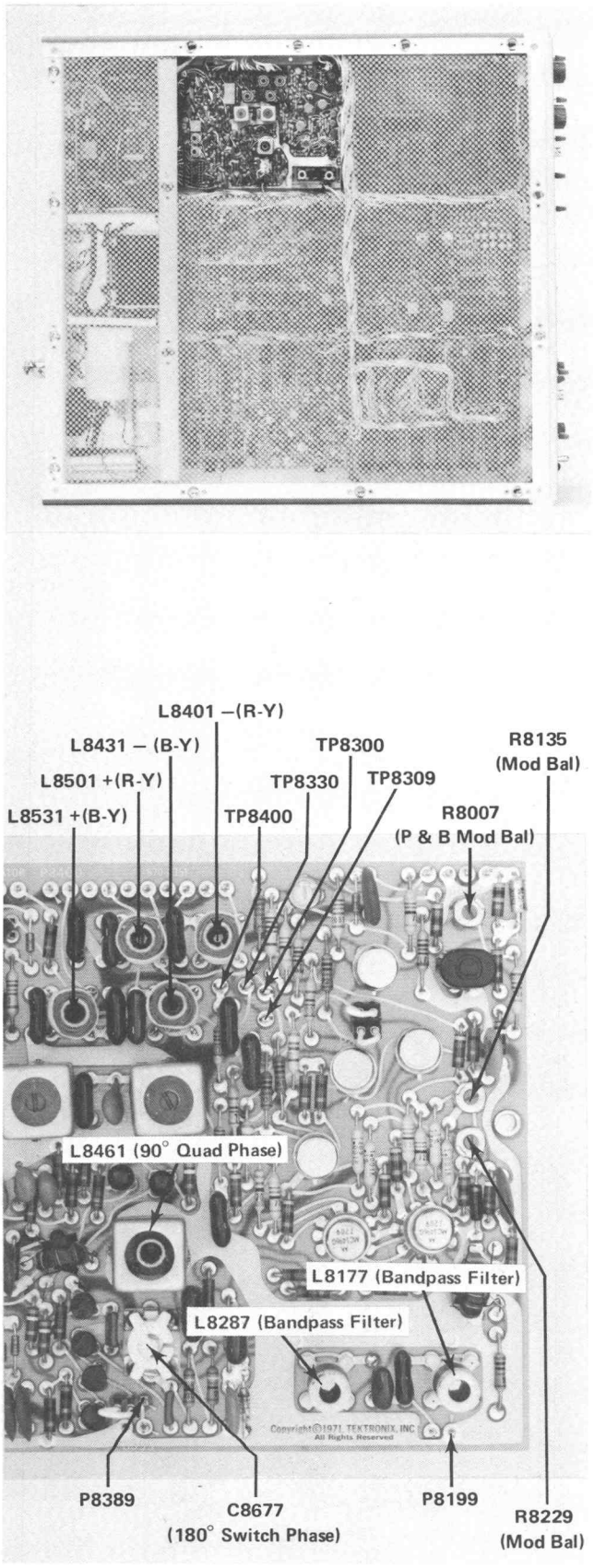


Fig. 4-10. Modulator test point, plug, and adjustment location.

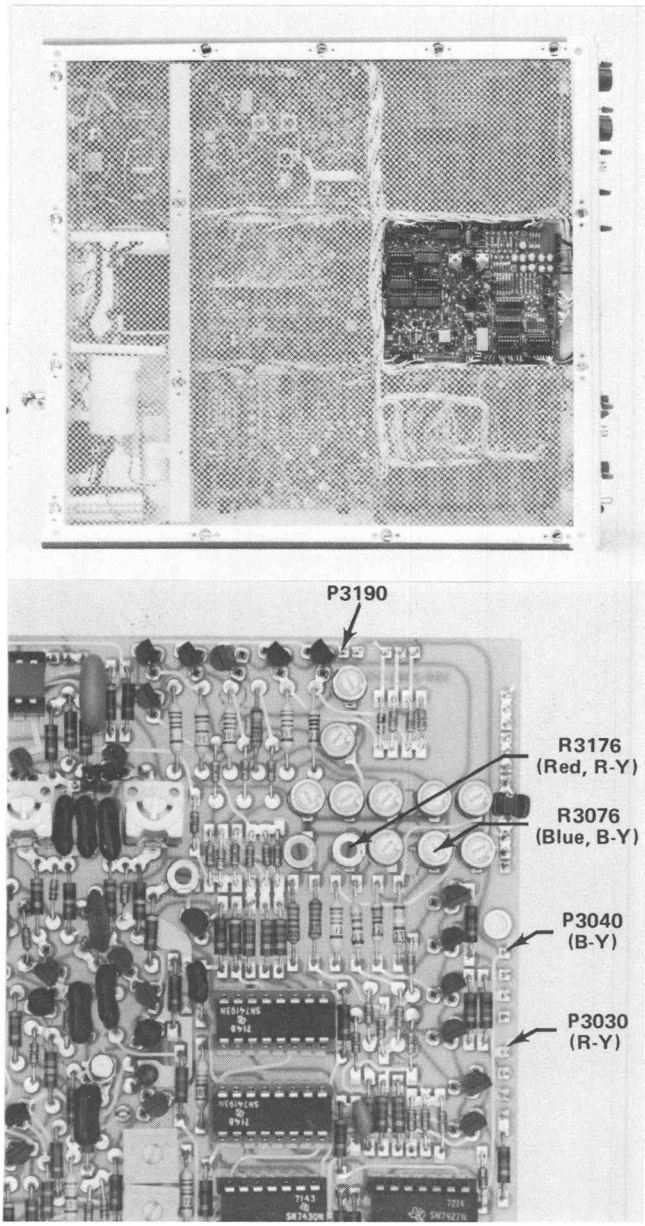


Fig. 4-11. Color Bar pin connector and adjustment location.

c. Set the FULL FIELD SIG switch to COLOR TEST SIGNAL.

ADJUST—R3176 (Red, R-Y) and R3076 (Blue, B-Y), see Fig. 4-11, for minimum modulation on the blanking level.

d. Repeat parts b and c. (Leave the FULL FIELD SIG switch at COLOR TEST SIGNAL while repeating.)

e. Set the FULL FIELD SIG switch to SIN² PULSE & BAR.

ADJUST—R8007 (P & B Modulator Balance), see Fig. 4-10, for minimum modulation on the blanking level.

3. Check/Adjust 180° Switch Phase

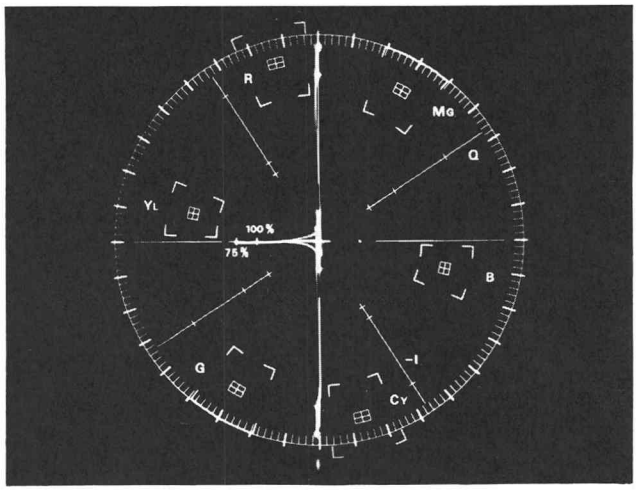
a. Set the FULL FIELD SIG switch to COLOR TEST SIGNAL. Change the connector on P8389, see Fig. 4-10, to pins 1 and 2 (alternate). Notice that there are alternate color bar vectors on the vectorscope display.

b. Disconnect plug P3040 (B-Y), see Fig. 4-11. Vary the vectorscope gain to put a color bar vector on the outer graticule ring (compass rose).

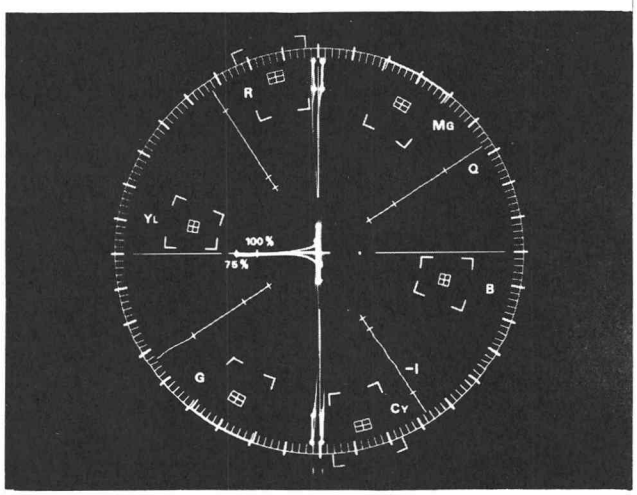
CHECK—Phase error between color bar vectors should be 0.5° or less, see Fig. 4-12.

NOTE

Fig. 4-12B shows misadjustment of the R-Y 180° Phase Switcher. Use the vectorscope calibrated phase dial to measure any error.



(A) R-Y 180° Phase Switcher properly adjusted.



(B) R-Y 180° Phase Switcher misadjusted.

Fig. 4-12. Typical Vectorscope displays used to check and/or adjust the R-Y 180° Phase Switcher.

ADJUST—C8677 (180° Switcher Phase), see Fig. 4-10, for best overlay of color dots; overlay should be within 0.5°.

c. Connect plug P3040 (B-Y) and disconnect plug P3030 (R-Y), see Fig. 4-11.

CHECK—Phase error between color dots should be 0.5° or less.

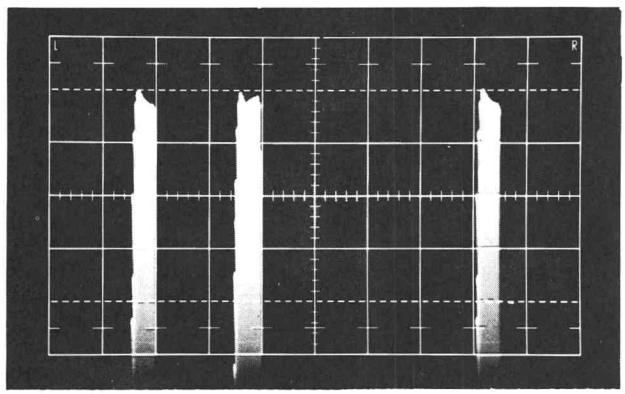
d. Connect plug P3030.

4. Preset Quadrature Phase

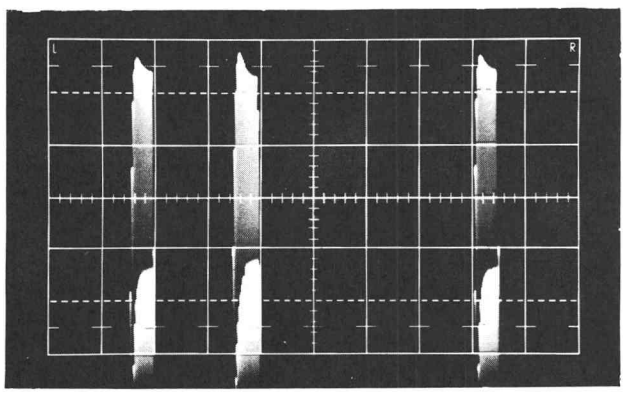
a. Set the test oscilloscope for a 10 mV/div deflection factor. Use the Vc offset control to position the tops of the cyan (2 nd) and red (5 th) color packets to the graticule center, see Fig. 4-13.

CHECK—Color bars should overlay within 10 mV. (See Fig. 4-13 for improper overlay.)

ADJUST—L8461 (90° Quad Phase), see Fig. 4-10, for best color bar overlay; should be within 10 mV.



(A) Correct color bar phasing.



(B) Incorrect color bar phasing.

Fig. 4-13. Typical displays showing correct and incorrect adjustment of color bar phasing.

b. Repeat parts 2b and 2c. (Leave the FULL FIELD SIG switch at COLOR TEST SIGNAL. Change the connector on P8389 to pins 2 and 3).

c. Repeat part 2e.

5. Check/Adjust Bandpass Filter Response

a. Set the SPLIT FIELD/FULL FIELD switch to SPLIT FIELD. Center the green to magenta transistion on the monitor. (See Fig. 4-17 for location of green and magenta.)

b. Disconnect P5971 and remove Q5991 to free-run the chrominance signal, see Fig. 4-14.

CHECK—Vectorscope display should be similar to that shown in Fig. 4-15.

CHECK—Monitor display should be similiar to that shown in Fig. 4-16.

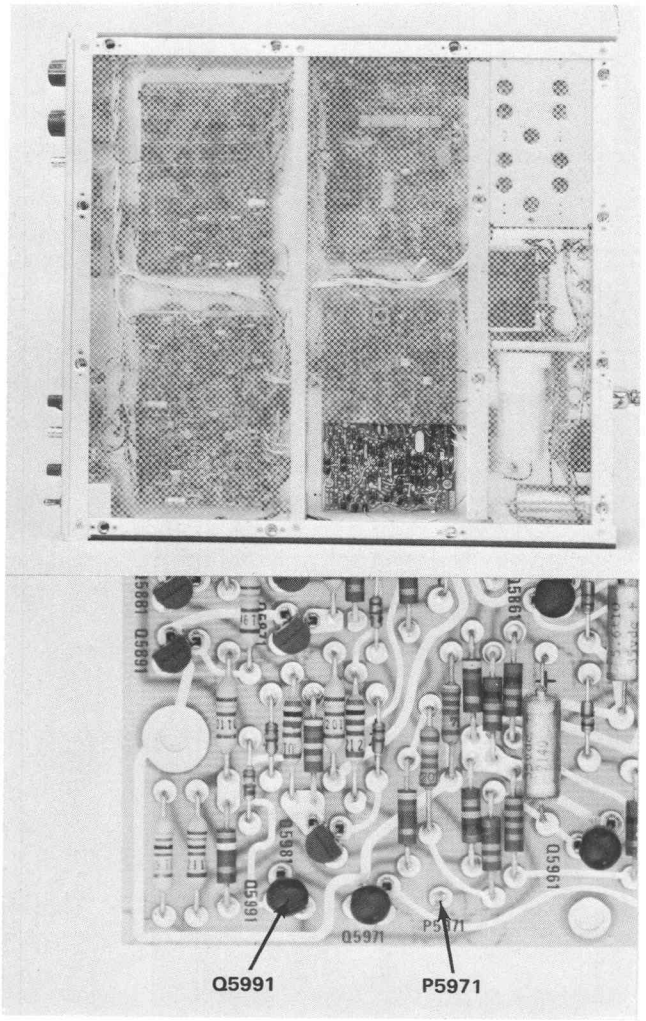


Fig. 4-14. Free-running chrominance component location.

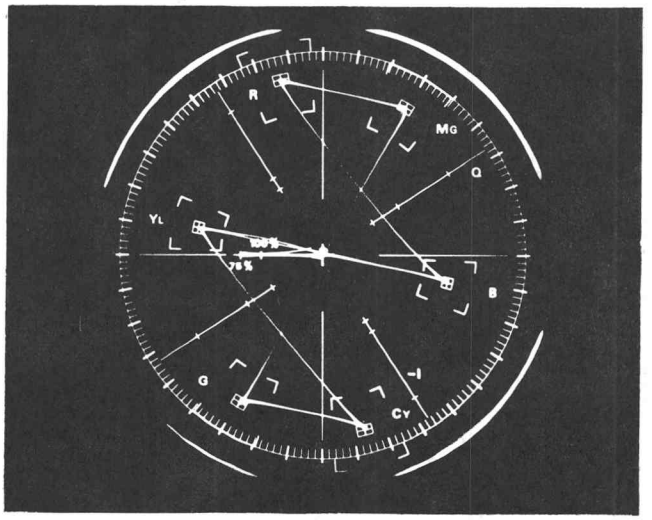
CHECK—Harmonics should be 40 dB or more below the reference signal.

NOTE

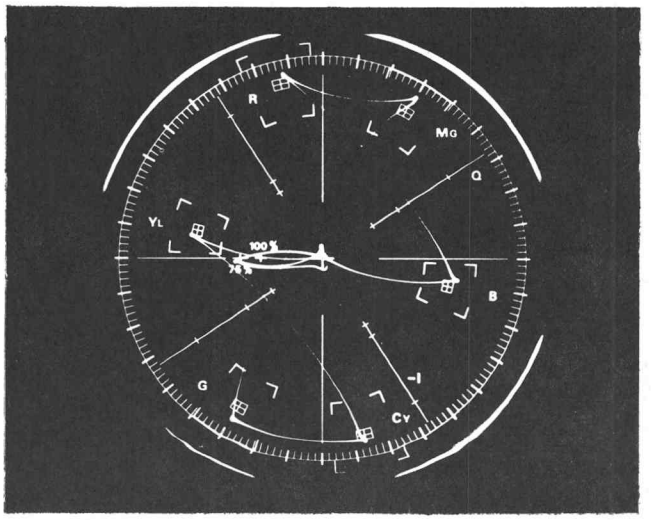
The adjustments in this step affect the harmonic content of the output signal. Only slight adjustment from the original calibration should be attempted without using a spectrum analyzer. See Group 16, Step 5 for information.

ADJUST—L8287 and L8177 (Bandpass Filter), see Fig. 4-10, for a vector display with straight lines, and for a monitor display having a null at the crossover point.

c. Connect P5971 and install Q5991.

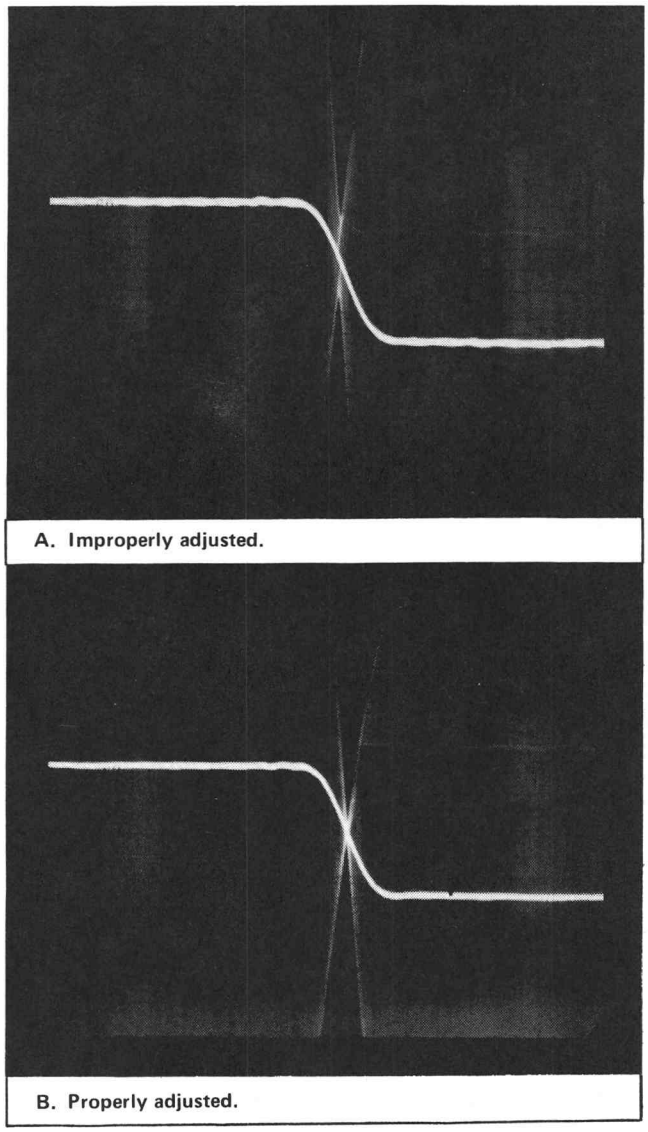


A. Correctly adjusted.



B. Incorrectly adjusted.

Fig. 4-15. Color filter adjustment.



A. Improperly adjusted.

B. Properly adjusted.

Fig. 4-16. Bandpass Filter Response.

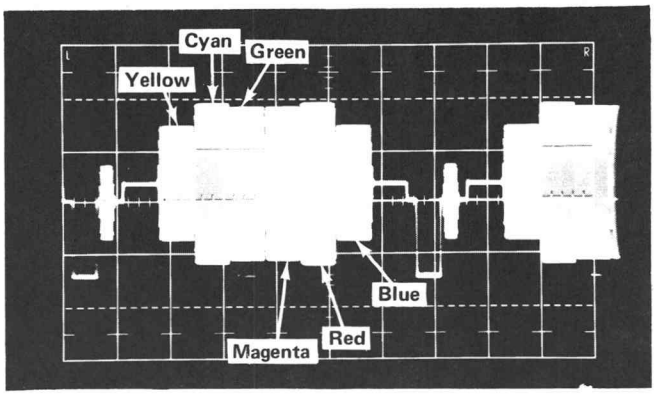


Fig. 4-17. Color signal component locations.

NOTE

Adjustments performed in step 2 through step 5 of this group interact. Repeat as necessary.

6. Check/Adjust Quadrature Phase

a. Display the FULL FIELD TEST signal on the test oscilloscope. Connect P8389, see Fig. 4-10, between pins 1 and 2 (alternate). Set the test oscilloscope for a 10 mV/div deflection factor. Use the Vc offset control to position the tops of the cyan (2 nd) and red (5 th) color packets to the graticule center, see Fig. 4-13.

CHECK—Color bars should overlay within 2 mV at tops and bottoms of the color bars.

ADJUST—L8461 (90° Quad Phase) for best color bar overlay; should be within 2 mV at tops and bottoms of the color bars.

b. Connect P8389 between pins 2 and 3 (normal). Set the FULL FIELD SIG switch to FLAT FIELD.

ADJUST—R8229 and R8135 (Modulator Balance), see Fig. 4-10, for minimum modulation on the blanking level.

c. Set the FULL FIELD SIG switch to COLOR TEST SIGNAL.

ADJUST—R3176 (Red, R-Y) and R3076 (Blue, B-Y), see Fig. 4-11, for minimum modulation on the blanking level.

7. Check Spurious Subcarrier Amplitude

a. Observe the area of the color bar signal between blue and the front porch (set up level).

CHECK—Residual subcarrier should be 2.5 mV or less.

b. Observe the area of the color bar signal between the back porch and yellow (white reference).

CHECK—Residual subcarrier should be 2.5 mV or less.

c. Observe the starting point of the white reference portion of the signal.

d. Disconnect P3190 (Y), see Fig. 4-11 or Fig. 4-19.

CHECK—Aberration at the start of the white reference should be 32 mV or less.

8. Check Chrominance Amplitudes

a. Check Total Amplitudes. Connect the rear-panel FULL FIELD TEST signal to the test oscilloscope. Connect the chopper to the test oscilloscope. Display the chopped signal (see the NOTE following item 6 of the Test Equipment Used list and Fig. 4-18). Leave P3190 (Y) disconnected.

CHECK—Total chrominance amplitudes as follows (V_2 readings include a 3% tolerance).

Color	Chopper	
	V_1 (mV)	V_2 (mV)
Blue, Yellow	–223.3	209.9 to 236.8
Red, Cyan	–314.1	295.5 to 333.2
Green, Magenta	–295.2	277.6 to 313.4

b. Check Relative Amplitudes. Measure the red color bar amplitude and apply the result to the formula:

$$\frac{V_1 \text{ (standard value)} + V_2 \text{ (measured)}}{2V_1 \text{ (standard value)}} \times 100 = \text{red relative amplitude in \%}$$

where V_1 (standard value) is the absolute value given for the chopper V_1 in the table, and V_2 (measured) is the value measured.

EXAMPLE: Assume that red measured 320.4 mV. Applying the formula:

$$\frac{314.1 + 320.4}{(2)\ (314.1)} \times 100 = 101.0\%\ .$$

Note that the red color bar is 1% above the standard value.

Repeat this step for each remaining color listed in part a. All other amplitudes should be within 1% of the red relative amplitude.

EXAMPLE: Assume blue measured 232.3 mV. Applying the formula:

$$\frac{223.3 + 232.3}{(2)\ (223.3)} \times 100 = 102.0\%\ .$$

Note that the blue color bar is within 1% of the red relative amplitude.

c. If the above requirements are met, go to step 12. If the above requirements are not met, steps 9, 10, and 11 must be performed.

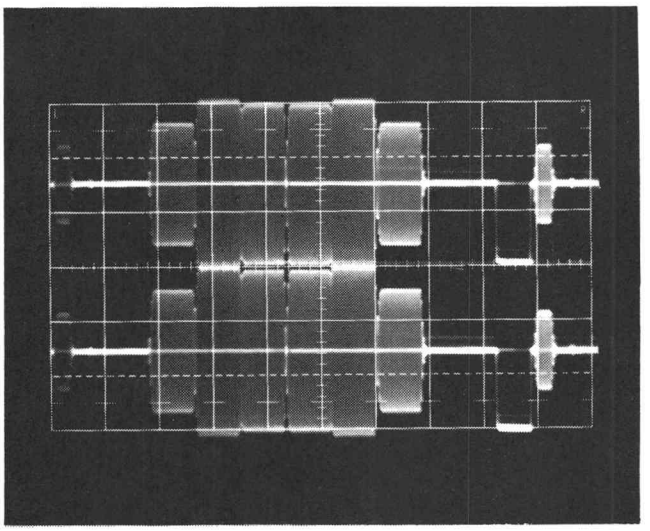


Fig. 4-18. Chopped waveform display.

9. R-Y Chrominance

a. Disconnect plug P3040 (B-Y). See Fig. 4-19 for plug and adjustment locations. Leave P3190 (Y) disconnected.

b. Adjust R-Y chrominance. Set R3274 (Blue, R-Y) to midrange, then use the following table for adjustment sequence.

Adjust	Color	Chopper	
		V_1 (mV)	V_2 (mV)
R7661 (Mod Gain)	blue	–47.9	47.9
R3074 (Green, R-Y)	green	–257.5	257.5
R3176 (Red, R-Y)	magenta	–257.5	257.5
R3274 (blue, R-Y)	blue	–47.9	47.9
R3074 (green, R-Y)	green	–257.5	257.5
R3176 (Red, R-Y)	Minimum modulation on the blanking level		

c. Check R-Y chrominance. R-Y chrominance should be within 1% or 1 mV as follows.

Color	Chopper	
	V_1 (mV)	V_2 (mV)
red, cyan	–305.3	299.1 to 311.5
blue, yellow	–47.9	46.8 to 48.9
green, magenta	–257.5	252.3 to 262.6

d. Connect plug P3040.

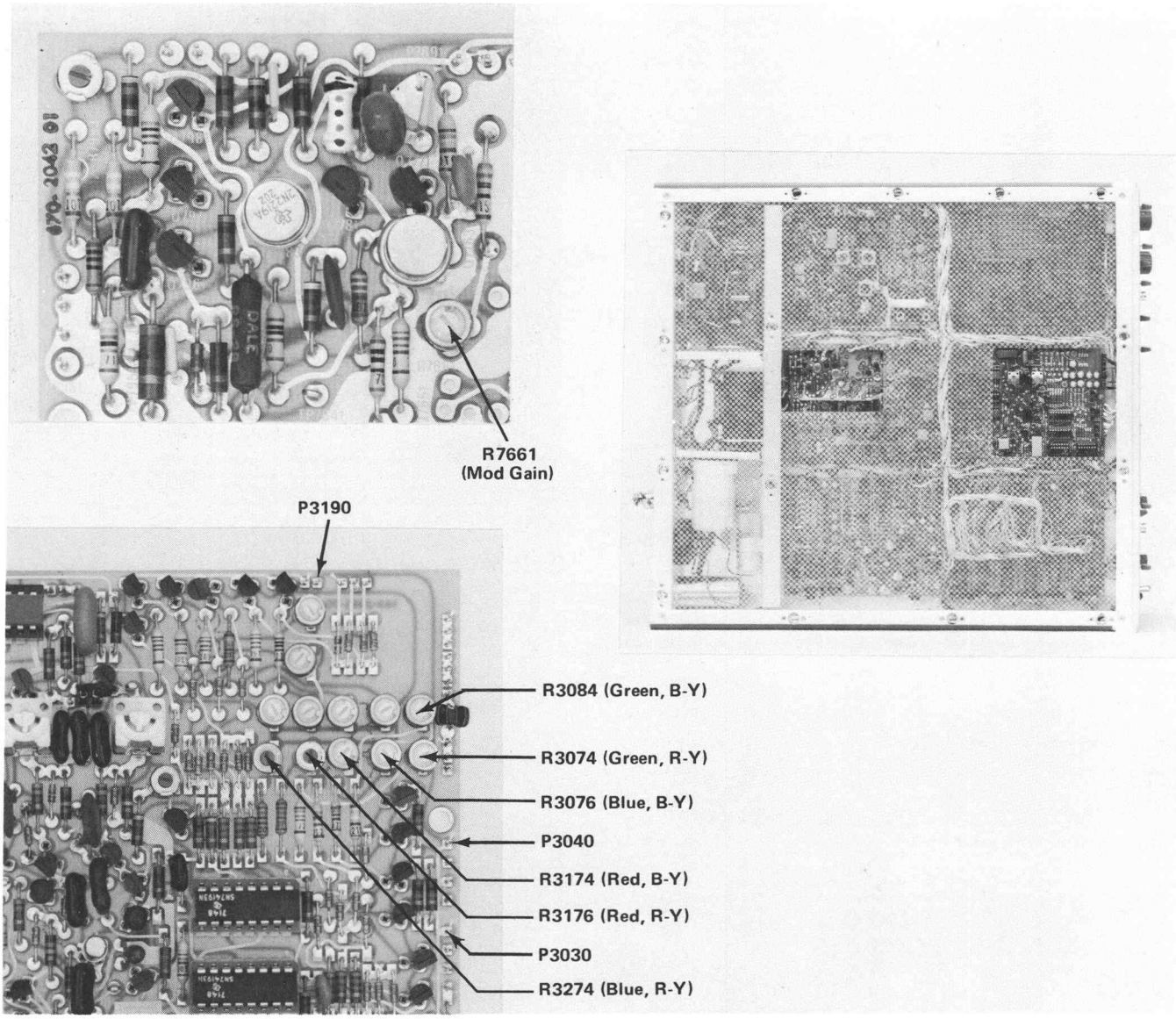


Fig. 4-19. Color Bar pin connector and adjustment location.

10. B-Y Chrominance

a. Disconnect plug P3030 (R-Y). Leave P3190 (Y) disconnected. See Fig. 4-19 for plug and adjustment locations.

b. Adjust B-Y chrominance. Use the following table for adjustment sequence.

Adjust	Color	Chopper	
		V_1 (mV)	V_2 (mV)
R3174 (Red, B-Y)	red	−73.4	73.4
R3084 (Green, B-Y)	green	−144.6	144.6
R3076 (Blue, B-Y)	magenta	−144.6	144.6
R3174 (Red, B-Y)	red	−73.4	73.4
R3084 (Green, B-Y)	green	−144.6	144.6
R3076 (Blue, B-Y)	Minimum subcarrier on the blanking level		

c. Check B-Y chrominance. B-Y chrominance should be within 1% as follows.

Color	Chopper	
	V_1 (mV)	V_2 (mV)
blue, yellow	–218.1	213.7 to 222.5
red, cyan	–73.4	72.0 to 74.9
green, magenta	–144.6	141.7 to 147.5

d. Connect plug P3030.

11. Check Total Chrominance Amplitudes

Repeat step 8.

12. Check/Adjust Modulated Pedestal Chrominance

Set the COLOR BARS/MODULATED PEDESTAL/50 IRE PEDESTAL switch to MODULATED PEDESTAL. Leave P3190 (Y) disconnected.

CHECK—Modulated pedestal chrominance as follows.

Pedestal	Tolerance	Chopper	
		V_1 (mV)	V_2 (mV)
20 IRE	0.1 IRE	–71.61	70.89 to 72.32
40 IRE	0.1 IRE	–143.32	142.61 to 144.03
80 IRE	0.1 IRE	–286.76	286.05 to 287.47

ADJUST—Modulated pedestal chrominance as follows. See Fig. 4-20 for adjustment location.

Adjust	Chopper	
	V_1 (mV)	V_2 (mV)
R493 (20 IRE)	–71.61	71.61
R492 (40 IRE)	–144.32	144.32
R484 (80 IRE)	–286.76	286.76

13. Check/Adjust 50 IRE PEDESTAL

Set the COLOR BARS/MODULATED PEDESTAL/50 IRE PEDESTAL switch to 50 IRE PEDESTAL. Connect plug P3190 (Y).

CHECK—Pedestal amplitude should be between 355.2 and 362.3 mV (50 IRE within 0.5 IRE).

ADJUST--R3186 (50 IRE Pedestal), see Fig. 4-21, for 358.8 mV (50 IRE Pedestal).

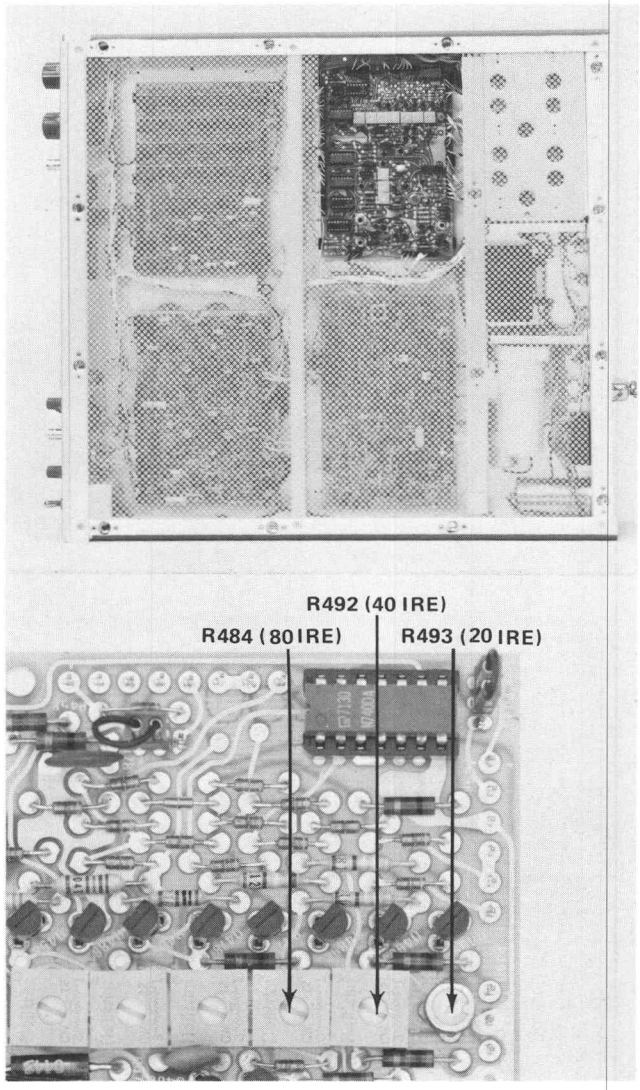


Fig. 4-20. Modulated Pedestal chrominance adjustment location.

14. Check/Adjust Color Bar Luminance

a. Set the COLOR TEST SIGNAL switches TO COLOR BARS and SPLIT FIELD and connect P3190 (Y).

CHECK—Luminance levels to the value given:

Black	53.2 to 54.2 mV
Blue	107.3 to 109.4 mV
Red	200.8 to 204.8 mV
Magenta	255.2 to 260.3 mV
Green	344.0 to 350.9 mV
Cyan	397.9 to 405.5 mV
Yellow	491.8 to 501.5 mV
White	710.2 to 724.7 mV

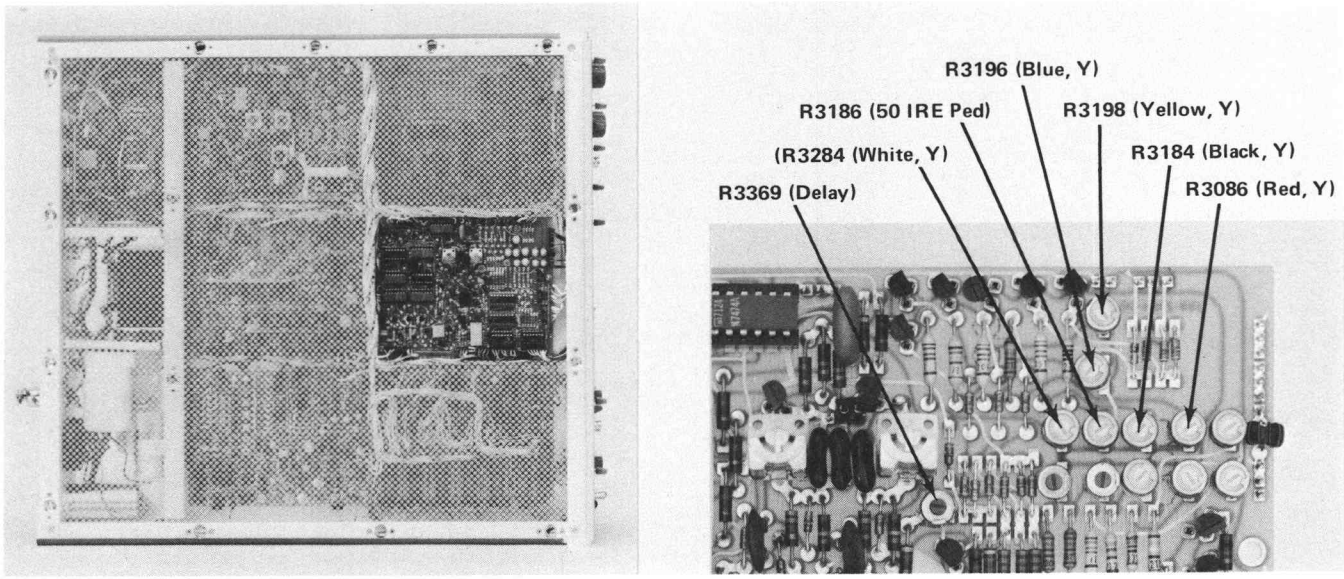


Fig. 4-21. Pedestal and Color Bar luminance adjustment location.

ADJUST—Luminance levels to the value given (see Fig. 4-21 for adjustment locations):

R3184 (Black, Y)	53.7 mV
R3196 (Blue, Y)	108.3 mV
R3086 (Red, Y)	202.8 mV
R3198 (Green, Y)	347.4 mV
R3284 (White, Y)	717.5 mV

b. If adjustments are made, repeat the CHECK portion of this step before continuing.

15. Check SPLIT FIELD Sequence

Display the rear-panel FULL FIELD TEST signal on the monitor.

CHECK—The SPLIT FIELD signal should start with luminance, switch to a half field of chrominance, then switch back to luminance.

16. Check MODULATED PEDESTAL Phase

Set the COLOR TEST SIGNAL switch to MODULATED PEDESTAL.

CHECK—Chroma to burst phase as displayed on the vectorscope should be 90° within 1°.

CHECK—Phase error between the different chrominance levels should be 0.2° or less.

17. Check/Adjust Luminance to Chrominance Delay

a. Set the COLOR TEST SIGNAL switch to COLOR BARS. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope. Set the test oscilloscope to display the green, magenta cross-over point, see Fig. 4-22A.

b. Disconnect plug P5971 and remove Q5991, see Fig. 4-14.

c. Set the test oscilloscope vertical gain and positioning controls so that the luminance component is 4 to 5 div high and exactly centered vertically, see Fig. 4-22B.

CHECK—Luminance transition crosses through the chrominance null at the 50% amplitude point (CRT center) within 20 ns. (See Fig. 4-22C for chrominance null.)

ADJUST—R3369 (Delay), see Fig. 4-21, for matching luminance to chrominance, within 20 ns.

18. Check Chrominance Envelope Risetime

a. Disconnect plug P3190 (Y), see Fig. 4-19.

CHECK—Yellow (1st) chrominance envelope risetime should be between 323 and 431 ns.

b. Connect plug P5971 and install Q5991.

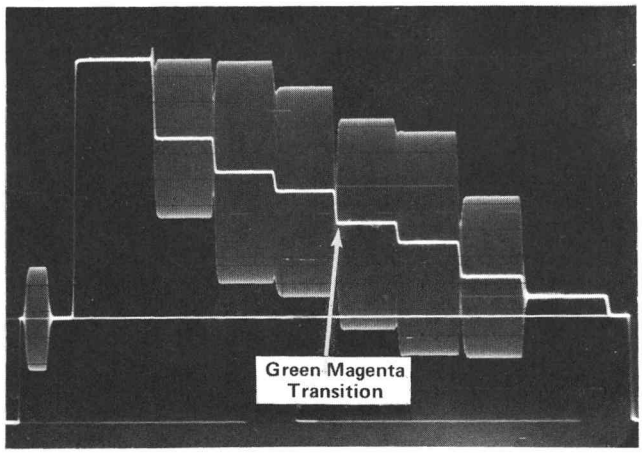
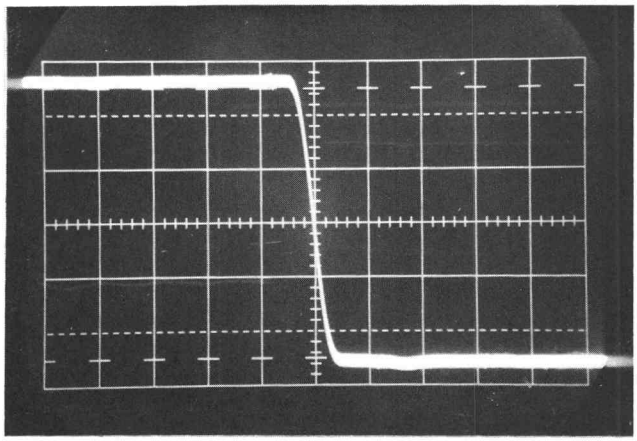
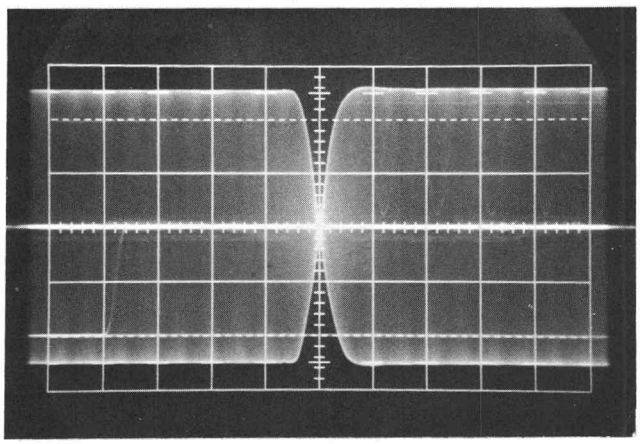


Fig. 4-22A. Color bar component location.



B. Properly centered luminance display.



C. Properly centered chrominance display.

Fig. 4-22B, C. Typical displays to check or adjust luminance to chrominance delay.

19. Check Modulated Pedestal Duration

Set the COLOR TEST SIGNAL switch to MODULATED PEDESTAL.

CHECK—Modulated Pedestal duration as given:

20 IRE modulation	13 μs wide
40 IRE modulation	13 μs wide
80 IRE modulation	13 μs wide

GROUP 4-MODULATED PULSE LUMINANCE

1. Check Modulated Pulse Luminance

a. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope. Set the FULL FIELD SIG switch to SIN² PULSE & BAR.

CHECK—Trailing corner of the modulated 12.5 T pulse should be flat.

CHECK—12.5 T pulse should be symmetrical.

CHECK—12.5 T pulse Half Amplitude Duration (HAD) should be 1.57 μs within 75 ns (1.495 to 1.645 μs).

b. If these requirements are met, go to GROUP 5.

2. Adjust Modulated Pulse Luminance

a. Connect a 10X probe to TP6301, see Fig. 4-23. Disconnect plug P8199, see Fig. 4-23, to disable the modulator.

ADJUST—R6458 (Mod Pulse Level), see Fig. 4-23, for the best trailing corner of the 12.5 T pulse.

b. Change the connector on P6050 to pins 1 and 2 (20 T).

ADJUST—R6362 (Mod Pulse Symmetry) for a symmetrical pulse. Measure at the HAD points.

ADJUST—R6354 (Mod Pulse Width) for a pulse width of 2.5 μs within 0.1 μs measured at the HAD points.

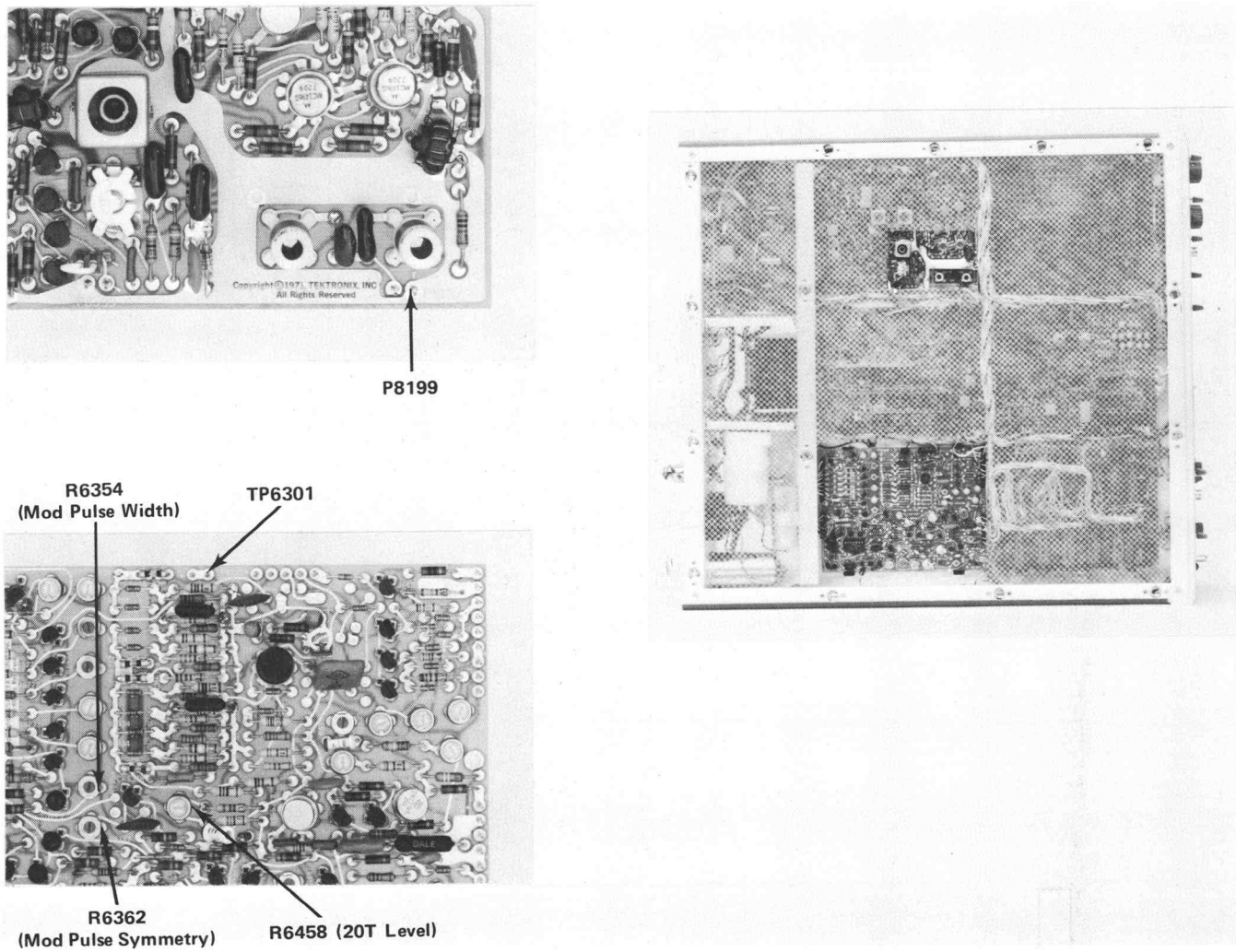


Fig. 4-23. Modulated Pulse test point, pin connector and adjustment locations.

c. Change the connector on P6050 to pins 2 and 3 (12.5 T). Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope.

ADJUST—R6362 and R6354 for a symmetrical 12.5 T pulse; width at the HAD points should be 1.495 μs to 1.645 μs.

d. Connect plug P8199.

GROUP 5-MULTIBURST

1. Check Multiburst Amplitude and Frequency

a. Set the FULL FIELD SIG switch to MULTIBURST. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope and the front-panel FULL FIELD SIG OUT signal on the monitor and vectorscope.

CHECK—Multiburst Amplitude; 500 kHz burst should be between 423.4 and 437.7 mV (60 IRE within 1 IRE).

b. Set the MULTIBURST AMPLITUDE switch to 90 IRE.

CHECK—Multiburst Amplitude, 500 kHz burst should be between 638.9 and 653.2 mV (90 IRE within 1 IRE).

CHECK—Multiburst Accuracy

Burst	Tolerance	Test Oscilloscope Display
500 kHz	3%	2 ~ in 8 div ±0.24 div at 0.5 μs/div
1.25 MHz	3%	2 ~ in 8 div ±0.24 div at 0.2 μs/div
2.0 MHz	3%	4 ~ in 10 div ±0.3 div at 0.2 μs/div
3.0 MHz	3%	3 ~ in 10 div ±0.3 div at 0.1 μs/div
3.58 MHz	3%	3 ~ in 8.13 to 8.63 div at 0.1 μs/div
4.1 MHz	2%	3 ~ in 7.17 to 7.46 div at 0.1 μs/div

CHECK—Harmonics should be at least 40 dB below the reference signal.

c. If these requirements are met go to step 4c.

2. Preset Multiburst

NOTE

The adjustments in this step affect the harmonic content of the Multiburst signal. Only slight adjustment from the original calibration should be attempted without using a spectrum analyzer. See Group 16, Step 5, for information. In addition, if more than a slight adjustment is made to the listed controls, check the following:

Control	Check	Group	Step
R6942 (MB Sync Level)	P & B Mod Bal	3	2e
	P & B Level	6	1d
R6898 (Harmonics)	12.5T Width	4	2c
R6741 (MB Gain)	P & B Level	6	1d
	P & B Chroma	8	2
	12.5T Ampl	8	2

a. Set R6938 (MB Setup Level) to maximum CW.

NOTE

Refer to Fig. 4-24 for all adjustments in this group.

b. Adjust R6673 (MB Centering) to match the level of the 4.1 MHz burst to the 0 reference level on the vectorscope Y display, see Fig. 4-25.

ADJUST—R6736 (MB Bandpass) for best flat top between bursts, i.e., adjust so that any tilt between the first and last burst packets is minimum.

c. Set the MULTIBURST AMPLITUDE switch to 60 IRE.

ADJUST—C7463 (MB 60 IRE Flatness) for the best average flat response, top and bottom, on the monitor display.

d. Set the MULTIBURST AMPLITUDE switch to 90 IRE.

ADJUST—C7461 (MB 90 IRE Flatness) for the best average flat response, on the monitor display.

e. Adjust R6741 (MB Gain) for exactly 90 IRE (646.1 mV) of 500 kHz burst. Refer to the NOTE following step 2.

f. Adjust R6942 (MB Sync Level) to overlay the multiburst front porch and the 0 reference level (baseline) of the monitor display. Refer to the NOTE following step 2.

g. Adjust R6977 (MB Harmonics) for best multiburst bottom.

ADJUST—C6693 (MB Harmonics) for best multiburst top, on the monitor display. Refer to the NOTE following step 2.

h. Readjust C7463, then C7461, for best flat multiburst at 60 IRE and 90 IRE, using the monitor display.

i. Repeat parts b and c.

3. Adjust Frequencies and Harmonics

a. ADJUST—Frequencies in the sequence given.

Adjust	Tolerance	Test Oscilloscope Display
R6304 (500 kHz)	±3%	2 ~ in 8 div ±0.24 div at 0.5 μs/div
R6202 (1.25 MHz)	±3%	2 ~ in 8 div ±0.25 div at 0.2 μs/div
R6314 (2 MHz)	±3%	4 ~ in 10 div ±0.3 div at 0.2 μs/div
R6324 (3 MHz)	±3%	3 ~ in 10 div ±0.3 div at 0.2 μs/div
R6334 (3.58 MHz)	±3%	3 ~ in 8.13 to 8.63 div at at 0.1 μs/div[3]
R6344 (4.1 MHz)	±3%	3 ~ in 7.17 to 7.46 div at 0.1 μs/div

[3] **This can be set by using the vectorscope and adjusting R6334 for a null on the vector display.**

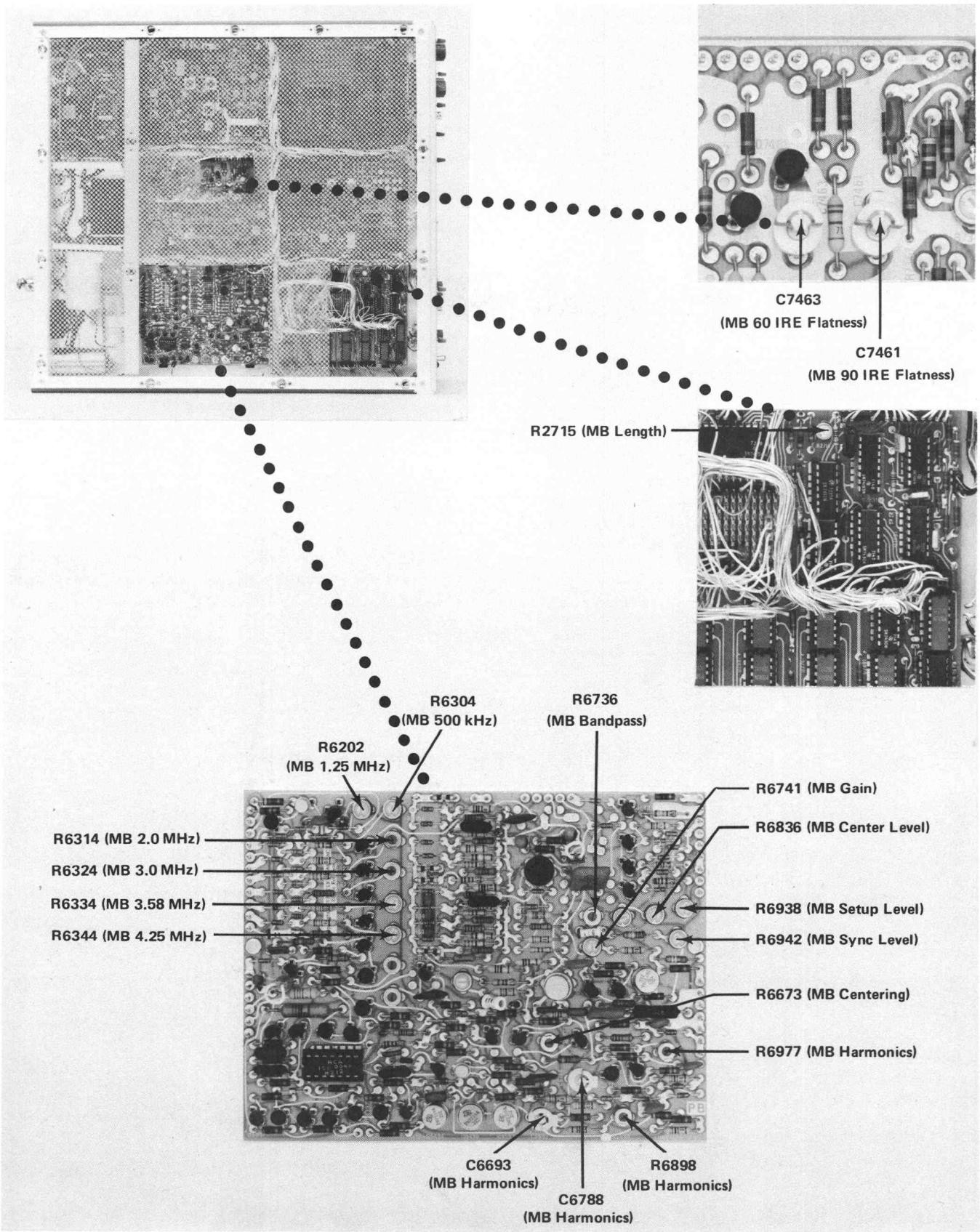


Fig. 4-24. Multiburst adjustment location.

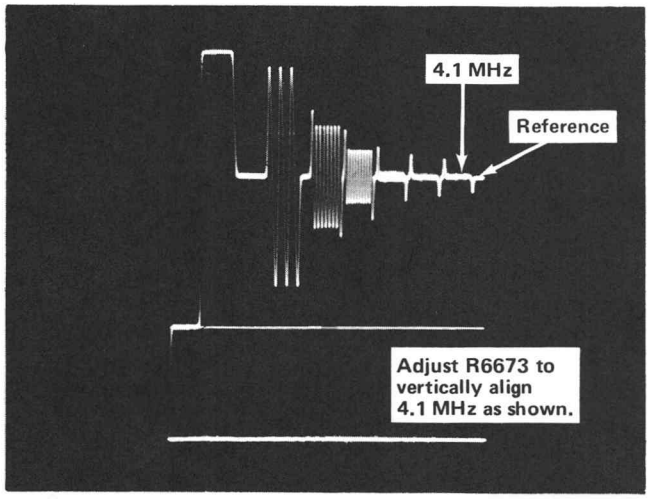


Fig. 4-25. Typical vectorscope display (Y) of Multiburst luminance.

b. ADJUST—R2715 (MB Length) for 4 cycles of 500 kHz burst and whole cycles for the remaining bursts.

c. ADJUST—R6977 (Harmonics) and C6693 (Harmonics) for best harmonic content and multiburst flatness.

d. ADJUST—R6898 (Harmonics) and C6788 (Harmonics) for best harmonic content and multiburst flatness.

e. Repeat parts 2b through 3d as needed.

4. Check/Adjust Multiburst Amplitude

a. CHECK—Burst Amplitude should be 90 IRE within 1 IRE (638.9 to 653.2 mV at the 500 kHz burst).

ADJUST—R6741 (MB Gain) for a multiburst amplitude of 90 IRE (646.1 mV).

b. Set the MULTIBURST AMPLITUDE switch to 60 IRE.

CHECK—Amplitude should be 60 IRE within 1 IRE (423.4 to 437.7 mV).

c. CHECK—MB flatness at 60 IRE and 90 IRE amplitudes should be within 1 IRE at the top and 1 IRE at the bottom.

ADJUST—C7463 (60 IRE) and C7461 (90 IRE) for best multiburst flatness within 1%.

NOTE

Adjusting C7463 and C7461 does not affect the multiburst frequency. However, the harmonic content will be greater with positive multiburst tilt.

5. Check/Adjust Multiburst Zero Levels

a. Set the MULTIBURST AMPLITUDE switch to 90 IRE.

CHECK—Level of 4.1 MHz burst matches the 0 reference level on the vectorscope Y display, see Fig. 4-25.

ADJUST—R6673 (MB Centering) to match the level of the 4.1 MHz burst to the 0 reference level.

b. CHECK—Multiburst back porch matches the 0 V DC output level on the monitor display.

ADJUST—R6942 (MB Sync Level) to match the MB back porch to the 0 V DC output level.

6. Check/Adjust Multiburst Pedestal Amplitude

CHECK—Multiburst pedestal amplitude should be 100 IRE within 1 IRE (710.2 to 724.7 mV).

ADJUST—R6833 (MB Pedestal Ampl) for a pedestal amplitude of 100 IRE (717.5 mV).

7. Check/Adjust Multiburst Center Level

a. CHECK—Average multiburst center level should be 55 IRE within 1 IRE (387.4 to 401.5 mV).

ADJUST—R6836 (MB Center Level) for a center level of 55 IRE (394.4 mV).

b. Set the MULTIBURST AMPLITUDE switch to 60 IRE.

CHECK—60 IRE average level should be 40 IRE within 1 IRE (279.6 to 293.8 mV).

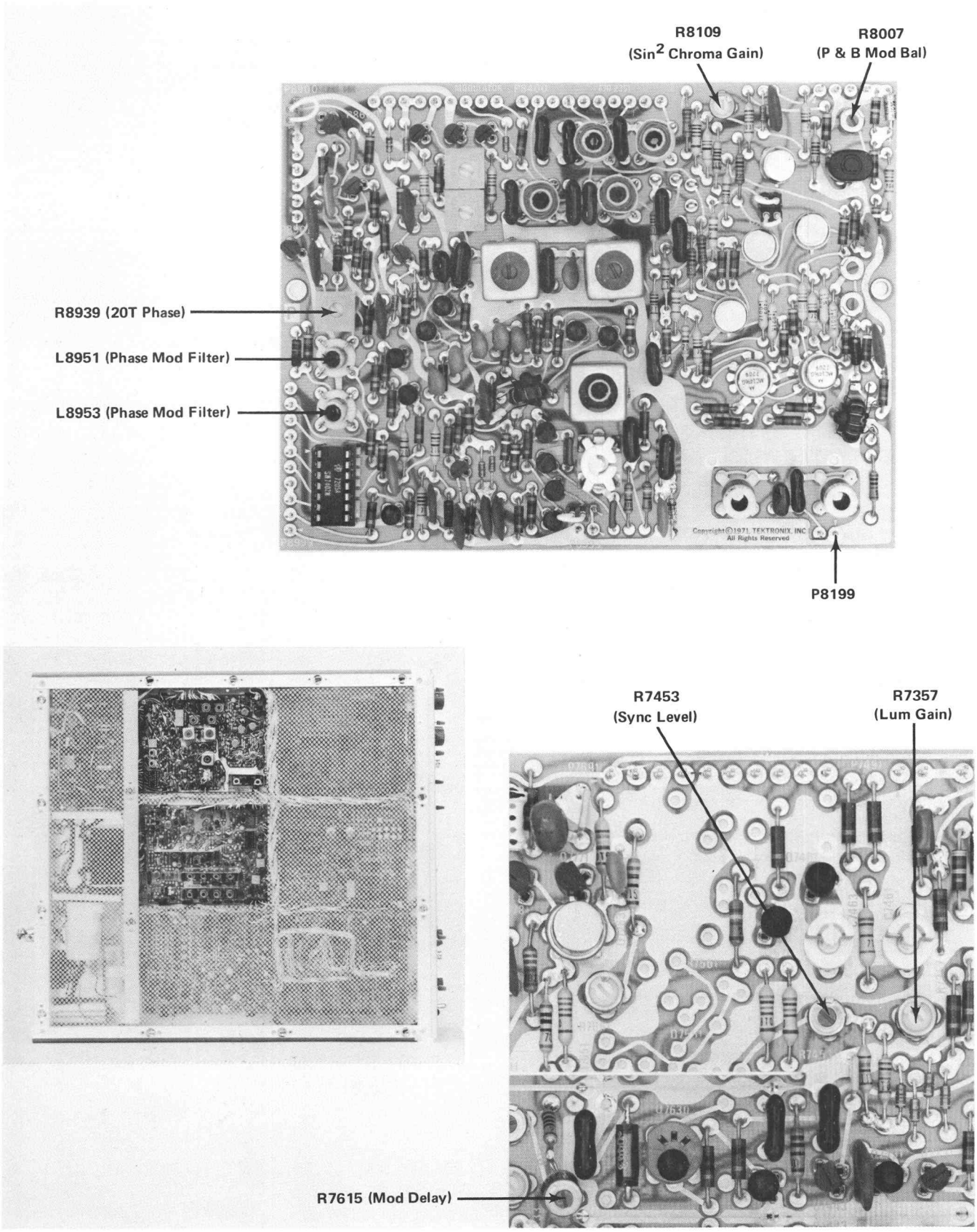


Fig. 4-26. Modulated Pulse Chrominance pin connector and adjustment location.

GROUP 6-MODULATED PULSE CHROMINANCE

1. Preset Chrominance

a. Set the FULL FIELD SIG switch to SIN² PULSE & BAR. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope and the front-panel FULL FIELD SIG OUT signal on the monitor and vectorscope.

b. Refer to Fig. 4-26 for all adjustments in this group.

c. CHECK—Modulation on baseline should be less than 2.5 mV.

ADJUST—R8007 (P & B Modulator Balance) for minimum modulation on the blanking level.

d. (Calibration Only) Disconnect plug P8199. Preset R7357 (Luminance Gain) for a 12.5T pulse amplitude of exactly 50 IRE (358.8 mV). Preset R7453 (P & B SYNC Level) to align the blanking levels on the monitor display. Connect plug P8199. Preset R8109 (Sin² Chroma Gain) for a modulated 12.5T Pulse having a 100 IRE amplitude.

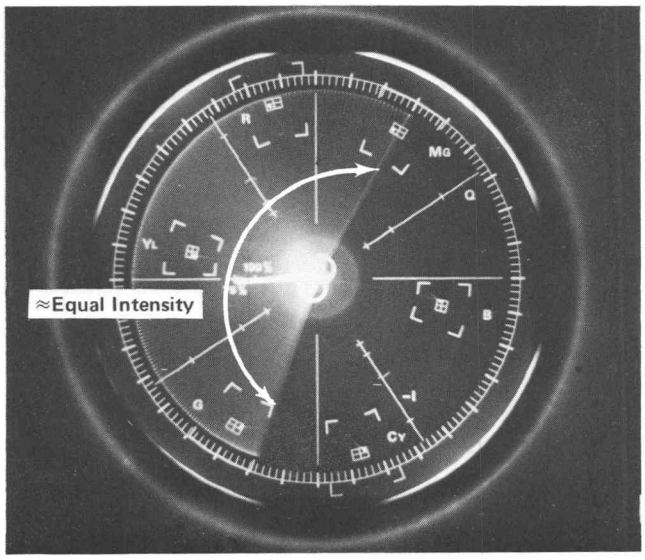


Fig. 4-27. Typical vectorscope display of modulated pulse when variable modulation filters are adjusted.

2. Check/Adjust Modulation Delay and Var Mod Filters

Display the bottom of the modulated 12.5T pulse on the monitor.

CHECK—Baseline ripple on the bottom of the pulse should be 0.6 IRE or less.

CHECK—Vector display is similar to that shown in Fig. 4-27, and should end at magenta.

ADJUST—R7615 (Mod Delay) for symmetrical modulation on the 12.5T pulse; also adjust L8591 and L8593 (Var Mod Filter) for best vector display.

ADJUST—R8939 (20T Phase) so that the vector display stops at magenta.

GROUP 7-LUMINANCE

1. Check/Adjust FULL FIELD TEST SIGNAL Amplitudes

a. Set the FULL FIELD SIG switch to FLAT FIELD. Set the APL switch to VARIABLE and the VARIABLE switch to 100. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope and the front-panel FULL FIELD SIG OUT signal on the monitor. Set the chopper amplitude to match the FLAT FIELD amplitude; should be between 710.0 and 724.4 mV.

CHECK—Amplitudes should be as follows:

Signal	Amplitude
MULTIBURST	710.0 to 724.4 mV (100 IRE within 1 IRE)
COLOR BARS	710.0 to 724.4 mV (100 IRE within 1 IRE)
SIN² P & B	710.0 to 724.4 mV (100 IRE within 1 IRE)
LINEARITY, RAMP	639.7 to 652.5 mV (90 IRE within 1 IRE)
10 STEP	639.7 to 652.5 mV (90 IRE within 1 IRE)
5 STEP	567.1 to 581.2 mV (80 IRE within 1 IRE)

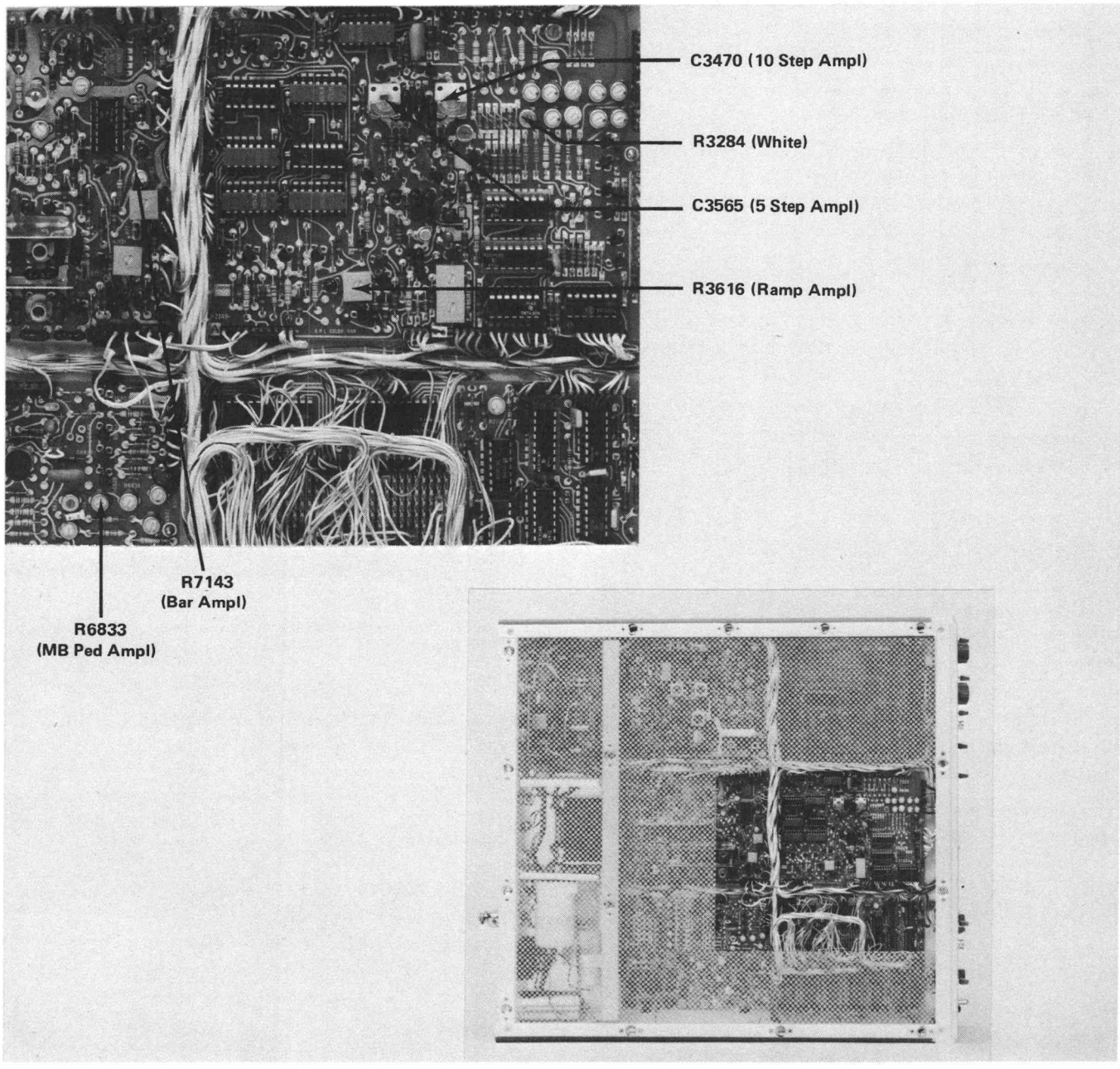


Fig. 4-28. Luminance adjustment locations.

ADJUST—Amplitudes as given below. See Fig. 4-28 for adjustment locations.

Signal	Adjust	Amplitude
MULTIBURST	R6833 (MB Ped Ampl)	match FLAT FIELD setting
COLOR BARS	R3284 (White)	match FLAT FIELD setting
SIN^2 P & B	R7143 (Bar Ampl)	match FLAT FIELD setting
LINEARITY, RAMP	R3616 (Ramp Ampl)	match FLAT FIELD setting
10 STEP	C3470 (10 Step Ampl)	match FLAT FIELD setting
5 STEP	C3565 (5 Step Ampl)	574.2 mV

b. Set the FULL FIELD SIG switch to FLAT FIELD. Set the VARIABLE switch to 0. Jumper or short pins 1 and

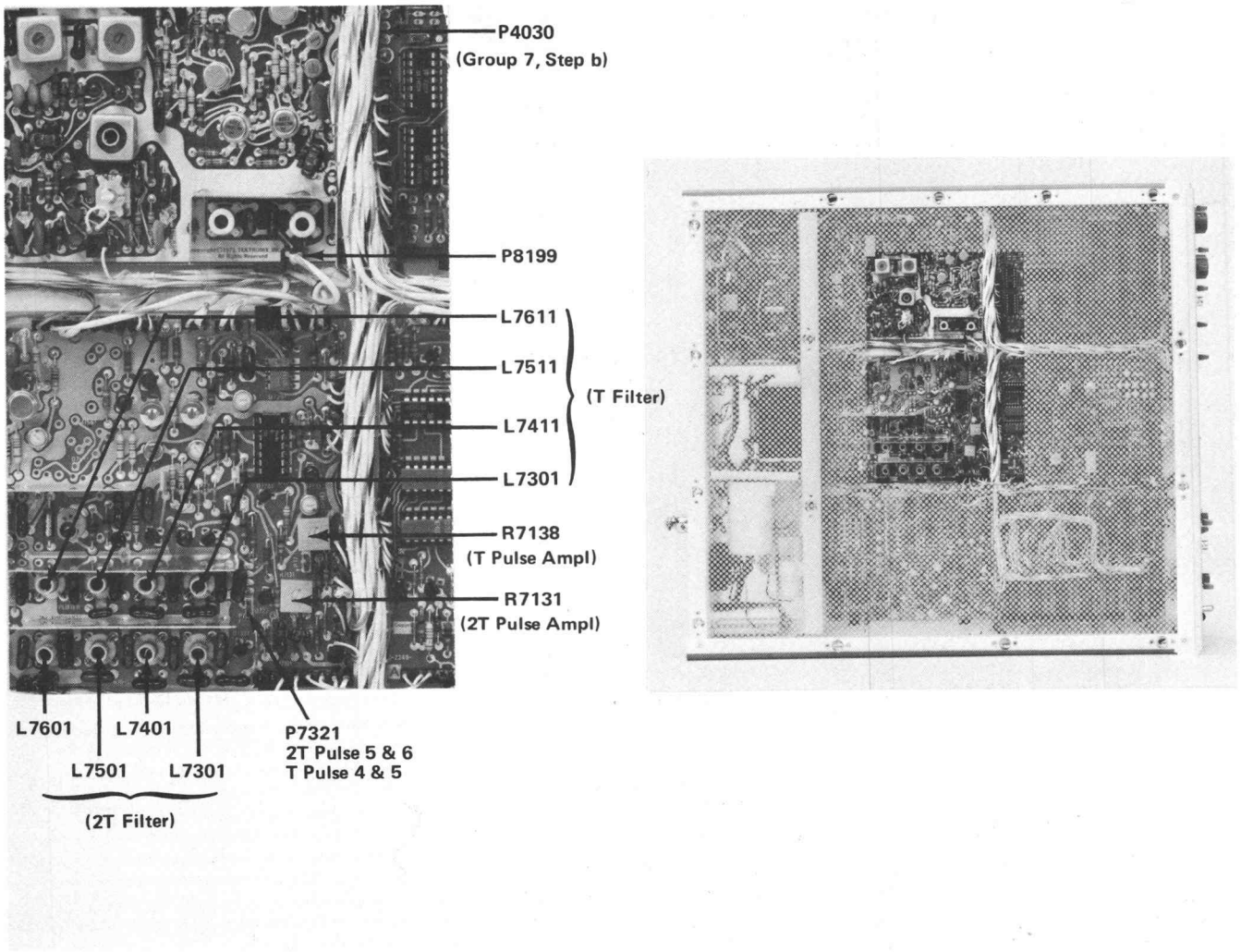


Fig. 4-29. VIRS pin connectors. Luminance Filter pin connectors and adjustment location. (Connection between pins 1 & 2 of P7321 produces T bar; pins 2 & 3 produces 2T bar).

2 of plug P4030, see Fig. 4-29, to put a VIRS on every line. Disconnect plug P8199 (modulator output).

CHECK—VIRS pedestal amplitudes should be as given below.

Signal Level	Amplitude
7.5 IRE	50.1 to 57.2 mV (7.5 IRE within 0.5 IRE)
50 IRE	355.2 to 362.3 mV (50 IRE within 0.5 IRE)
70 IRE	497.0 to 507.1 mV (70 IRE within 0.7 IRE)

ADJUST—Amplitudes as given below. See Fig. 4-30 for adjusted locations.

Signal	Adjust	Amplitude
7.5 IRE	R467 (VIRS Ped 7.5 IRE)	53.7 mV
50 IRE	R476 (VIRS Ped 50 IRE)	358.8 mV
70 IRE	R475 (VIRS Ped 70 IRE)	502.0 mV

c. Remove the jumper or short from plug P4030. Connect plug P8199.

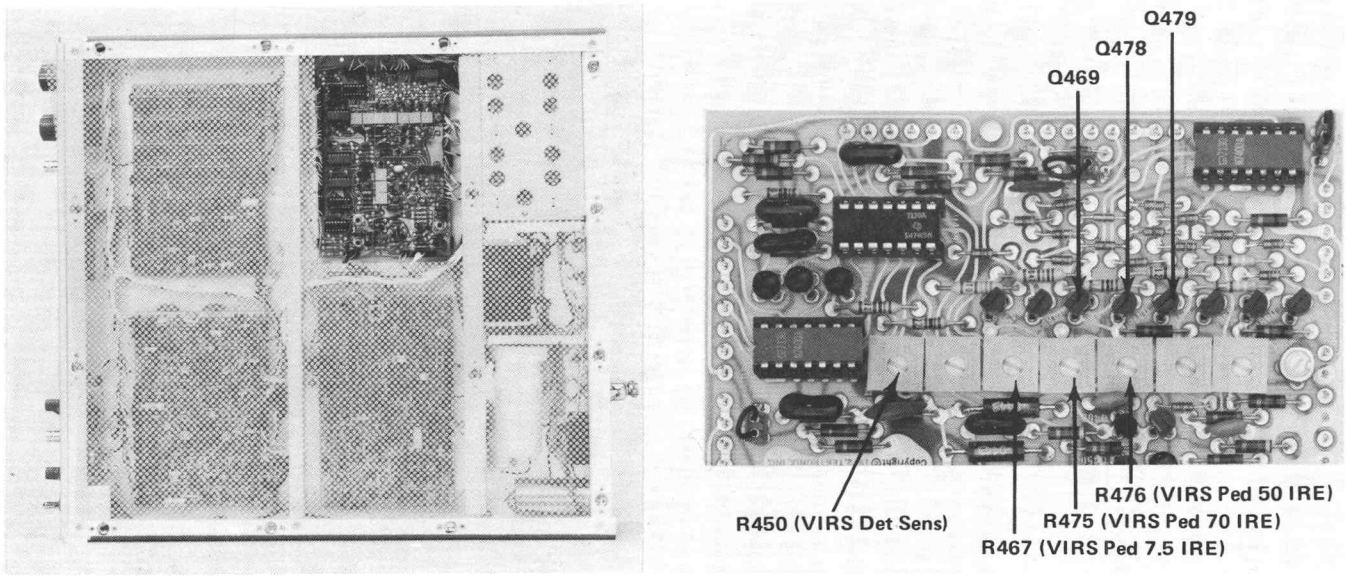


Fig. 4-30. VIRS pedestal adjustment and transistor location.

GROUP 8-PULSE AMPLITUDE AND WIDTH

1. Check/Adjust 2T and T Pulse Amplitude and Width

a. Set the FULL FIELD SIG switch to SIN² PULSE & BAR. Display the rear-panel FULL FIELD TEST signal on the monitor for amplitude and ringing measurement. Display the front-panel FULL FIELD SIG OUT signal on the test oscilloscope for pulse width measurement.

CHECK—2T Pulse to the characteristics given:

Amplitude: within 0.25% of bar;

HAD: 250 ns (242.5 to 257.5 ns);

Ringing: 0.5 IRE or less.

b. Change the connector on P7131 to pins 2 and 3 and the connector on P7321 to pins 4 and 5.

NOTE

See Fig. 4-29 for adjustments and pin connector locations for this group.

CHECK—T Pulse to the characteristics given:

Amplitude: within 0.25% of bar;

HAD: 125 ns (117.5 to 132.5 ns);

Ringing: 1 IRE or less.

ADJUST—L7311, L7411, L7511, and L7611 for a T Pulse HAD of 125 ns (117.5 to 132.5 ns); ringing, 0.5 IRE or less.

ADJUST—R7138 (T Pulse Amplitude) to match the bar amplitude within 0.25%.

c. Change the connector on P7131 to pins 1 and 2 and the connector on P7321 to pins 5 and 6.

ADJUST—L7301, L7401, L7501, and L7601 for a 2T Pulse HAD of 250 ns (242.5 to 257.5 ns); ringing, 1 IRE or less.

ADJUST—R7131 (2T Pulse Amplitude) to match the bar amplitude within 0.25%.

2. Check/Adjust Sin² (Modulated) Pulse

CHECK—Sin² pulse to the characteristics given:

Amplitude: within 0.5% of bar;

HAD: 2.5 μs within 1.0 μs;

Baseline Ripple: 0.6 IRE or less.

ADJUST—R7357 (Lum Gain), R8109 (Sin^2 Chroma Gain), R7615 (Mod Delay), L8591, L8593 (Var Mod Filter), and R7453 (P and B Sync Level) for a Sin^2 Pulse with characteristics given. (Refer to the adjustment sequence in Group 6.)

3. Check Harmonics

At this point in the procedure, all full-field signal harmonics should be 40 dB or more below the reference signal. See Group 16, Step 5 for information.

4. Check SIN² PULSE & BAR Risetimes

a. Set the FULL FIELD SIG switch to SIN² PULSE & BAR. Change the connector on P7321 to pins 1 and 2. Use the test oscilloscope to check that the bar goes through the T filter.

CHECK—T-Bar risetime should be 115 ns within 15% (98 to 132 ns).

b. Change the connector on P7321 to pins 2 and 3.

CHECK—2T-Bar risetime should be 250 ns within 15% (213 to 287 ns).

GROUP 9—CHROMINANCE

1. Check/Adjust VIRS Modulation Amplitude

a. Set the FULL FIELD SIG switch to FLAT FIELD. Set the VARIABLE switch to 0. Jumper or short pins 1 and 2 of plug P4030, see Fig. 4-29 to put a VIRS on every line. Remove Q479, Q478, and Q469 to remove the VIRS luminance (see Fig. 4-30).

b. Display the rear-panel FULL FIELD TEST signal on the test oscilloscope. Connect the chopper to the test oscilloscope. Display the chopped waveform. (See NOTE following item 6 of the Test Equipment Used list.)

CHECK—VIRS chrominance amplitude should be between 140.4 and 146.2 mV (40 IRE within 0.4 IRE).

ADJUST—R8727 (VIRS Mod Ampl), see Fig. 4-31, for a chrominance amplitude of 143.3 mV.

c. Install Q479, Q478, and Q469. Remove the jumper from plug P4030, pins 1 and 2.

2. Check/Adjust Burst Amplitude

CHECK—Burst Amplitude should be between 139.7 and 146.9 mV (40 IRE within 0.5 IRE).

ADJUST—R8705 (Burst Ampl) for a burst amplitude of 143.3 mV.

3. Check/Adjust LINEARITY Subcarrier Amplitude

a. Set the FULL FIELD SIG switch to LINEARITY and the SUBCARRIER switch to ON.

CHECK—Subcarrier amplitude should be between 139.7 and 146.9 mV (40 IRE within 0.5 IRE).

ADJUST—R3410 (40 IRE Mod Ampl) for a subcarrier amplitude of 143.3 mV.

b. Change the connector on P3400 to pins 1 and 2 (20 IRE).

CHECK—Subcarrier amplitude should be between 68.0 and 75.2 mV (20 IRE within 0.5 IRE).

ADJUST—R3420 (20 IRE Mod Ampl) for a subcarrier amplitude of 71.6 mV.

c. Change the connector on P3400 to pins 2 and 3.

4. Check Burst and VIRS Envelope Risetimes

a. Disconnect plug P5971 and remove Q5991 to free-run the chrominance signal, see Fig. 4-15.

CHECK—Burst envelope risetime should be 375 ns within 15% (323 to 431 ns).

b. Set the FULL FIELD SIG switch to FLAT FIELD. Set the VARIABLE switch to 0. Jumper or short pins 1 and 2 of plug P4030 (see Fig. 4-29) to put a VIRS on every line.

CHECK—VIRS envelope risetime should be 1 μs within 15% (0.85 to 1.15 μs).

ADJUST—L8629 and L8437 (VIRS Mod Filter), see Fig. 4-31, for the best front corner and a risetime of 0.85 to 1.15 μs.

c. Remove the jumper or short from plug P4030 pins 1 and 2. Connect plug P5971. Install Q5991.

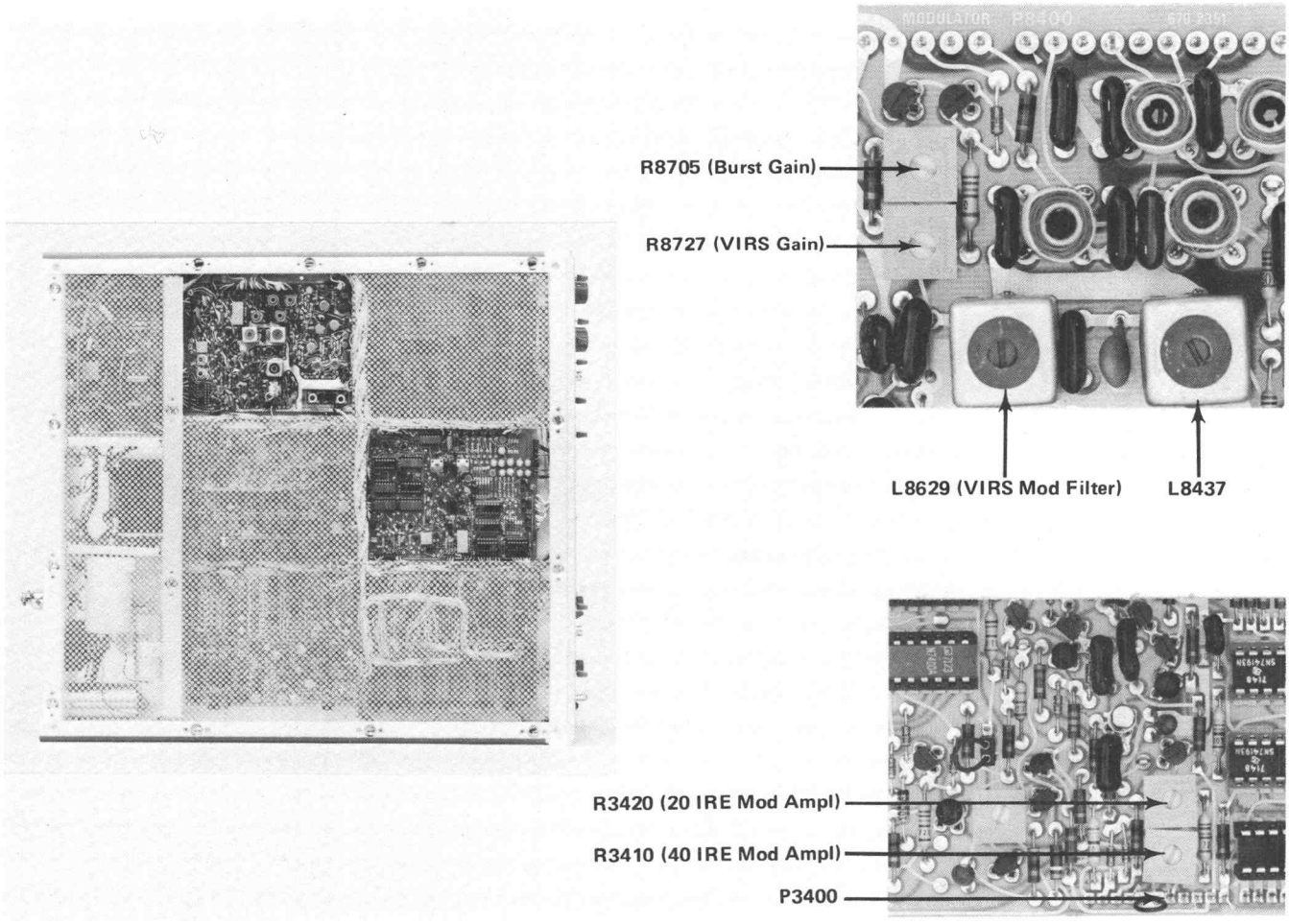


Fig. 4-31. Chrominance adjustment and pin connector location.

GROUP 10—FULL FIELD DIFF GAIN & PHASE

a. Refer to the Preliminary Procedure for setup.

b. Set the FULL FIELD SIG switch to LINEARITY. Set the vectorscope to measure differential gain.

CHECK—Diff gain should be 0.5% or less.

c. Set the vectorscope to measure differential phase.

CHECK—Diff phase should be 0.2° or less.

GROUP 11—VIRS SENSITIVITY

Connect the composite video signal to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN. Display line 20 of the PROGRAM LINE OUT signal on the monitor.

CHECK—VIRS display flickers and VIRS program indicator lamps on the front-panel flicker.

ADJUST—R450 (VIRS DET SENS), see Fig. 4-30, to the center of the detection range (flickering). Set the PROGRAM CONTROL UNITY GAIN/VAR. Set the LEVEL control for minimum amplitude. Notice the detector still works. If not, readjust R450 until the flickering starts. Set the PROGRAM CONTROL UNITY GAIN/VAR switch to UNITY GAIN.

GROUP 12—GEN-LOCK

NOTE

This group of checks requires the use of a video signal source with provisions to turn off burst or sync.

1. Check Light and Output Operation

a. Set the Video Signal source to provide a modulated staircase VITS on line 20 of both fields. Connect the PROGRAM LINE OUT signal to the monitor and display the vertical interval.

CHECK—NONSYNCHRONOUS MODE—NO VITS lamp is extinguished; ADD (amber), DELETE (red), and PROGRAM (green) lamps are lit; there is VITS and a VIR signal.

b. Turn off the video signal source sync.

CHECK—NON-SYNC (red) lamp is lit; ADD, DELETE, and PROGRAM lights are extinguished; there is no VITS and no VIR signal.

CHECK—There should be no signal available at the CW SUBCARRIER OUT or COMP SYNC outputs.

c. Turn the video signal source sync back on and the burst off.

CHECK—NON-SYNC, ADD, DELETE, and VIRS INCOMING lamps are extinguished; PROGRAM lamp is lit; there are VITS; the VIR signal has been replaced by the video signal source's modulated staircase VITS.

CHECK—There should be no signal available at the COMP SYNC output; there should be signal available at the CW SUBCARRIER output.

d. Turn on the video signal source burst.

CHECK—ADD and DELETE lamps are lit; a VIR signal is being displayed.

CHECK—There should be signal available at the CW SUBCARRIER output.

2. Check Sync Stripper Operation

a. Set the SYNC SOURCE switch to BLACK BURST.

CHECK—Loss of 149 VITS and the VIR signal.

b. Connect an external "Black Burst" signal to the BLACK BURST input, but do not terminate the loop-through. Use a 10X probe between the test oscilloscope and the test point.

CHECK—TP5290, see Fig. 4-32, for a composite sync amplitude of 0.8 to 1.2 V. V.

CHECK—P5294, pin 2, for a composite sync amplitude of 5.0 to 6.0 V.

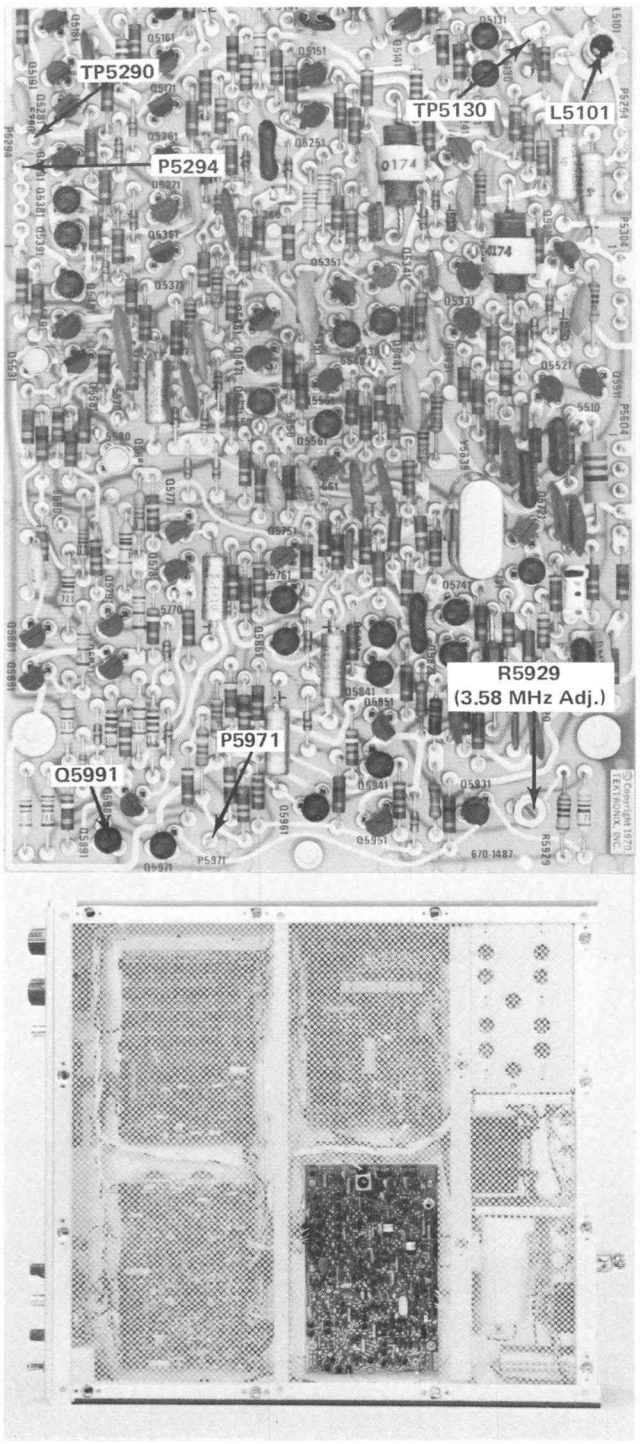


Fig. 4-32. Gen Lock test point, pin connector and adjustment location.

c. Set the SYNC SOURCE switch to PROGRAM LINE. Disconnect the BLACK BURST input signal.

CHECK—TP5290 should have about the same peak-to-peak signal gain with the video signal source sync on or off, and with either color bars or modulated staircase.

3. Check Chroma AGC Ratio

NOTE

R5929 (3.58 MHz Adj) is adjusted so that the chroma change is easier to see. It will be reset in step 4.

a. Connect a 10X probe to TP5130. Remove Q5991 and adjust R5929 for a chroma variation of about once a second.

CHECK—Chroma amplitude ratio should not vary more than 1:1.6.

b. Replace Q5991.

4. Adjust 3.58 MHz Frequency

a. Monitor the rear-panel FULL FIELD TEST signal on the vectorscope. Turn off the video signal source burst.

ADJUST—R5929 (3.58 MHz Adj) for minimum vector rotation (3.579545 MHz within 25 Hz).

b. Turn on the video signal source burst.

GROUP 13—VITS INSERTION, DIFF PHASE AND DIFF GAIN

1. Check/Adjust PROGRAM LINE OUT

a. Set the video signal source for a full-field modulated staircase test signal. Display the PROGRAM LINE OUT signal on the monitor and vectorscope.

b. Set the vectorscope to measure differential phase.

CHECK—Diff Phase should be 0.15° or less.

ADJUST—R735 (Diff Phase), see Fig. 4-35, for minimum differential phase 0.15° or less.

c. Set the vectorscope to measure differential gain.

CHECK—Diff Gain should be 0.2% or less.

2. Check PREVIEW OUT

Display the PREVIEW OUT signal on the monitor. Repeat the checks in step 1b and c except:

CHECK—Diff Gain should be 0.4% or less.

CHECK—Diff Phase should be 0.3° or less.

3. Check Programming

a. Display the PROGRAM LINE OUT signal on the monitor.

CHECK—VITS and a VIR signal exist, as indicated on the front-panel VITS INSERTION plate.

b. Using Table 4-4 as a guide, check that all internal connectors (as factory connected) are in the appropriate position.

Table 4-4

Factory Connected Internal Changes

Board & Plug No.	Connector Color	Connected to Pins:	Function
GEN LOCK			
P5141	blue	1 & 2 (Rear)	Subc Lock-Normal
APL, Staircase & Color Bars			
P3400	White	2 & 3 (rear)	40 IRE Subc
P3620	Black	1 & 2 (inbd)	Slow Ramp
P3760	Black	(FWD)	Staircase
P3470	Black	2 & 3 (Fwd)	5 Step—80 IRE
P3926	Blue	2 & 3 (Inbd)	Bounce—Line 57

Table 4-4 (cont)

Board & Plug No.	Connector Color	Connected to Pins:	Function
Sync			
P402	Red	1 & 2 (Inbd)	Modulated Pedestal
P478	Red	1 & 2 (Fwd)	Stoc 2
P499	Red	1 & 2 (Outbd)	—
Function Gen			
P6050	Orange	2 & 3 (Fwd)	12.5T Pulse
P6722	Violet	1 & 2 (Fwd)	Pulse & Bar, No Setup
Output			
P7131	Gray	1 & 2 (Outbd)	2T Pulse
P7321	Violet	2 & 3 (Outbd)	2T Bar
P7321	Gray	5 & 6 (Outbd)	2T Pulse
Modulator			
P8900	Orange	1 & 2 (Inbd)	Mod Pulse Φ Phase
P8327	Black	(Fwd)	Φ 180° Advance
P8389	Green	2 & 3 (rear)	Alt-Normal
VIT & FF Logic			
P4780	Black	1 & 2 (Rear)	Ext Sync
P4550	Blue	2 & 3 (Outbd)	VIRS, Alt Field Off
P4910	Brown	1 & 2 (outbd)	Linearity
P4820	None	None	Ext VITS Off
P4810	Red	2 & 3 (Inbd)	Sin^2 Pulse & Bar
P4200	Black	2 & 3 (Fwd)	Line 21 Delete
Spare 1	2 brown	Field 2, Line Off	Linearity
Spare 2	2 Red	Field 1, Line Off	Sin^2 Pulse & Bar
Composite	2 Orange	Field, Both, Line 19	—
Multiburst	2 Yellow	Field 1, Line 18	—
Color Bars	2 Green	Field 2, Line 18	—
VIRS	Blue	Field, Both	VIRS, Insert
P4140	Blue	2 & 3 (Rear)	VIRS Det Field 1

GROUP 14—VITS INSERTION

NOTE

The adjustments and checks in this group, except step 1, require that any errors in the full-field signal be noted or adjusted out.

Display the vertical interval of the rear-panel FULL FIELD TEST signal on the monitor. If the back porch of the Multiburst and Sin^2 Pulse & Bar signals are not superimposed with the blanking level they will show up as unwanted VITS pedestal error (steps 2b and 3b).

Small errors may be adjusted out without further recalibration. Adjust R6942 (MB Sync Level), see Fig. 4-24; adjust R7453 (P & B Sync Level), see Fig. 4-26.

The full-field signal output DC level should be close to 0 V. Adjust R7733 (DC Level), see Fig. 4-7.

All adjustments, except step 1, are shown in Fig. 4-35.

1. Check/Adjust Auxiliary Sync Level

Display the vertical interval of the PREVIEW OUT signal on the monitor.

CHECK—Display should be similar to the display shown in Fig. 4-34.

ADJUST—R7361 (Aux Sync Level), see Fig. 4-33, to match the levels as shown in Fig. 4-34.

2. Check/Adjust PROGRAM LINE OUT

a. Display the vertical interval of the PROGRAM LINE OUT signal on the monitor. Connect the video signal source

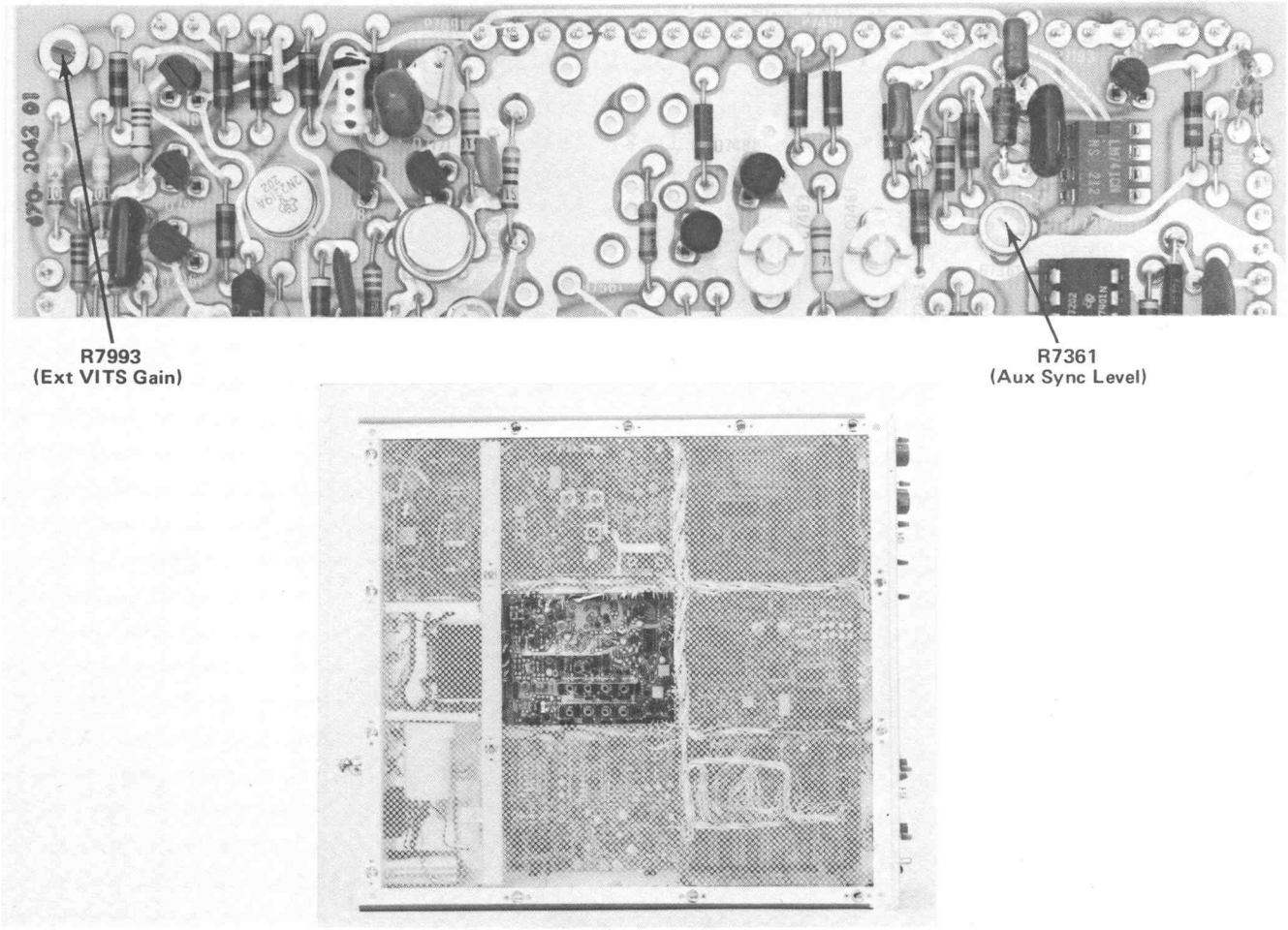


Fig. 4-33. Auxiliary sync level and external VITS gain adjustment location.

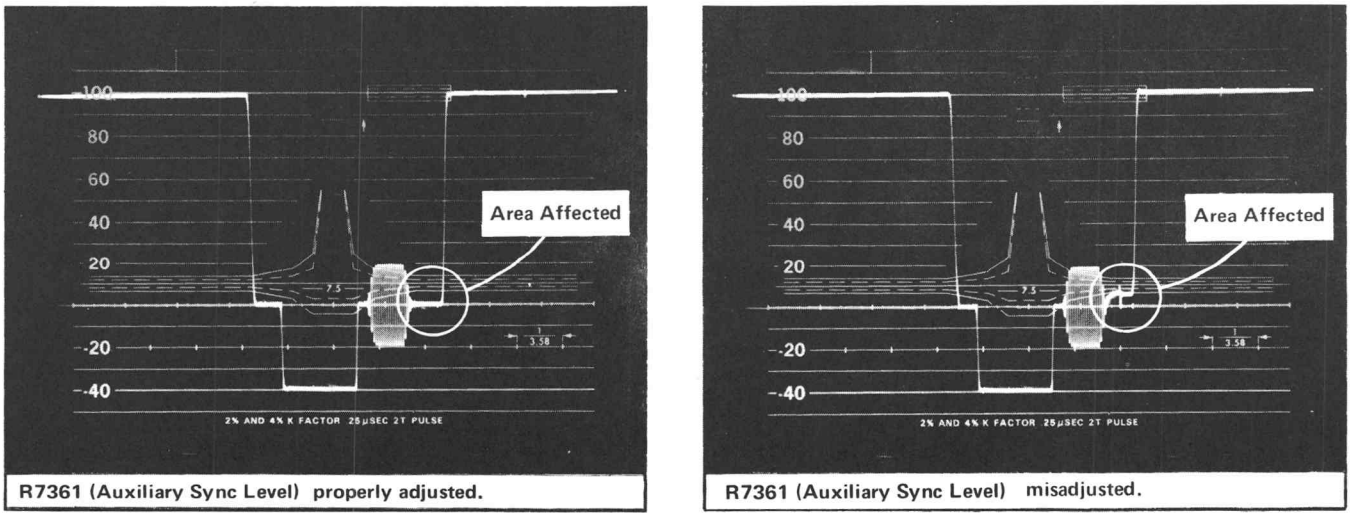


Fig. 4-34. Typical waveform monitor display used to check or adjust auxiliary sync level.

composite sync signal to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. Connect a cable from the rear-panel FULL FIELD TEST SIGNAL OUT to the PROGRAM LINE IN.

b. Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to 100.

CHECK—VITS blanking level (unwanted VITS pedestal) should be within 5 mV (0.7 IRE) of the blanking level for the non-inserted lines.

ADJUST—R775 (Prog Sync Level) to match the blanking levels.

CHECK—Blanking level (DC) should not change more than 50 mV when switching the PROGRAM CONTROL between PROGRAM and AUXILIARY.

ADJUST—R785 (Prog DC Level) so that no blanking level (DC) change occurs when switching between PROGRAM and AUXILIARY.

NOTE

The blanking level seen in the AUXILIARY mode is not necessarily 0 volts, but rather the blanking level of the full-field signal.

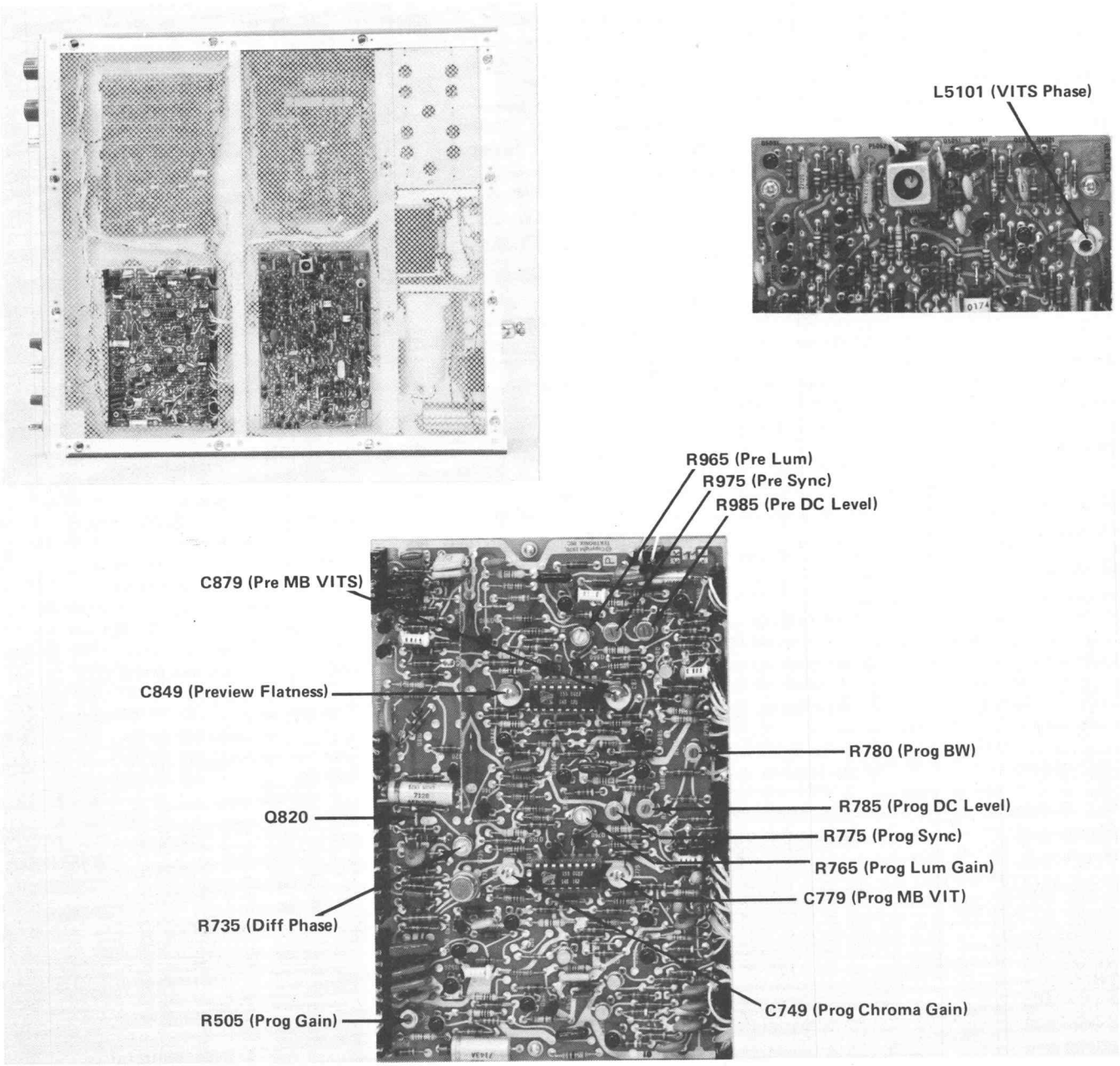


Fig. 4-35. VITS Insertion adjustment location.

c. Switch the PROGRAM CONTROL between PROGRAM, PREVIEW, and AUXILIARY.

CHECK—Blanking level (DC) of the display should not change between any mode. In addition, there should be no amplitude change of the VITS or full-field signals when switching between PROGRAM, PREVIEW, and AUXILIARY.

ADJUST—R505 (Prog Gain) so that no amplitude change of the VIT signal occurs while switching between PROGRAM and AUXILIARY.

ADJUST—R765 (Prog Lum Gain) so that no amplitude change of the full-field signal occurs while switching between PROGRAM and AUXILIARY.

d. Step b and c interact; repeat as necessary.

e. Set the FULL FIELD SIG switch to SIN^2 PULSE AND BAR. Switch the PROGRAM CONTROL between AUXILIARY and PROGRAM.

CHECK—2T Pulse to Bar; 100% within 0.25% (1.8 mV).

—12.5T Pulse to Bar; 100% within 0.5% (3.5 mV).

—12.5T baseline ripple; should be 0.5% or less (3.5 mV).

3. Check/Adjust PREVIEW MONITOR OUT

a. Note the DC level of the PROGRAM LINE OUT blanking level.

b. Display the PREVIEW MONITOR OUT signal on the test oscilloscope. Set the PROGRAM CONTROL switch to PREVIEW.

CHECK—Preview blanking level (DC) should be within 50 mV of the level noted in part a.

ADJUST—R975 (Pre Sync Level) so that the VITS blanking level matches the preview blanking level.

ADJUST—R985 (Pre DC Level) so that the preview blanking level matches the program blanking level within 50 mV. (0 volts plus any full-field blanking level error.)

c. Change the cable to display the PROGRAM OUT signal on the test oscilloscope. Note the overall amplitude of the signal. Change the cable to display the PREVIEW MONITOR signal.

CHECK—Preview signal overall amplitude should match the program signal overall amplitude within 1%.

ADJUST—R965 (Pre Gain) to match the preview signal to the program signal

d. Steps b and c interact; repeat as necessary.

e. Change the cable to display the other PREVIEW MONITOR signal.

CHECK—Preview signals should be the same amplitude.

4. Check Multiburst Flatness

a. Set the FULL FIELD SIG switch to MULTIBURST. Switch the PROGRAM CONTROL between PREVIEW and AUXILIARY.

CHECK—Tilt on preview multiburst signal (as measured between the first and last burst packets) should match the tilt of the full-field multiburst signal within 1%.

b. Display the PROGRAM MONITOR signal on the test oscilloscope. Switch the PROGRAM CONTROL between PROGRAM and AUXILIARY.

CHECK—Tilt on program multiburst signal should match the tilt of the full-field multiburst signal within 1%.

5. Check INSERT SUBCARRIER PHASE

a. Connect the video signal source to the PROGRAM LINE IN. Set the SYNC SOURCE switch to PROGRAM LINE. Display the PROGRAM LINE OUT signal on the vectorscope.

CHECK—INSERT SUBCARRIER PHASE control range is approximately 28°; range should be at least 5° on either side of the burst vector.

b. Set the INSERT SUBCARRIER PHASE control to overlay the burst and VITS vectors. Display the PREVEIW MONITOR signal on the vectorscope.

CHECK—Burst and VITS vectors should overlay (no phase error).

6. Check/Adjust Multiburst Flatness, Subcarrier Phase, and Pulse to Bar Ratios

NOTE

Adjustments in Step 6 affect the checks made in Step 2e, Steps 4a and 4b, and Steps 5a and 5b. After making the adjustments, repeat these checks.

a. Disconnect the video signal source from the PROGRAM LINE IN. Display the PROGRAM MONITOR signal on the test oscilloscope.

CHECK—TTL transients should be no more than 5 mV peak-to-peak.

NOTE

If the writing rate of the test oscilloscope is not sufficient to display these transients, do not adjust R780 or C779 at this time, but go to step c.

b. Preset C779 (Prog MB VITS) for minimum capacitance.

ADJUST—R780 (Program Bandwidth) for minimum TTL transients.

c. Connect the video signal source to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. Connect the FULL FIELD TEST signal to the PROGRAM LINE IN. Set the FULL FIELD SIG switch to MULTIBURST.

ADJUST—C779 (Prog MB VITS) so that the tilt of the full-field multiburst VIT signals are the same in either the PROGRAM or the AUXILIARY position of the PROGRAM CONTROL switch.

ADJUST—C749 (Program Chroma Gain) so that the tilt of the full-field multiburst VIT signals are the same in either the PROGRAM or the AUXILIARY position of the PROGRAM CONTROL switch.

d. Set the FULL FIELD SIG switch to SIN^2 PULSE AND BAR.

ADJUST—R780 (Program Bandwidth) so that the pulse and bar amplitudes are the same in either the PROGRAM or the AUXILIARY position of the PROGRAM CONTROL switch.

e. Steps c and d interact; repeat as necessary.

f. Check that the following signals are within the listed tolerances as the PROGRAM CONTROL is switched between AUXILIARY and PROGRAM.

CHECK—Program signal to full-field signal as follows:

MB VITS: within 1%.

Chroma Gain; within 1%.

2T Pulse to Bar ratio; 100% within 0.25% (1.8 mV)..

12.5T Pulse to Bar ratio; 100% within 0.5% (3.5 mV).

12.5T baseline ripple change; 0.5% or less (3.5 mV).

7. Check/Adjust INSERT SUBCARRIER PHASE

a. Connect the video signal source to the PROGRAM LINE IN. Set the SYNC SOURCE switch to PROGRAM. Display the PROGRAM OUT signal on the vectorscope.

CHECK—INSERT SUBCARRIER PHASE control range is approximately 28°; range is at least 5° on either side of the burst vector.

ADJUST—L5101 (VITS Phase) so that the INSERT SUBCARRIER PHASE control range is at least 5° on either side of the burst vector.

c. Rotate the INSERT SUBCARRIER PHASE control to overlay the VITS vector and the burst vector.

d. Display the PREVIEW MONITOR signal on the vectorscope.

CHECK—VIT signal vector and burst vector should overlay.

ADJUST—C849 (Preview Flatness) to overlay the VIT signal vector and the burst vector.

8. Check/Adjust PREVIEW MONITOR OUT

a. Connect the video signal source to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN.

b. Display the PREVIEW MONITOR signal on the monitor and vectorscope. Set the FULL FIELD SIG switch to MULTIBURST.

CHECK—Tilt of the full-field multiburst VIT signals are within 1% in either the REVIEW or the AUXILIARY position of the PROGRAM CONTROL switch.

ADJUST—C879 (Pre MB VITS) so that the tilt of the full-field multiburst VIT signals are within 1% in either the PREVIEW or the AUXILIARY position of the PROGRAM CONTROL switch.

CHECK—Tilt of the full-field multiburst signals are within 1% in either the PREVIEW or the AUXILIARY position of the PROGRAM CONTROL switch.

9. Check/Adjust Unity Gain

a. Display the FULL FIELD TEST signal on the test oscilloscope. Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to 100.

b. Connect the chopper to the test oscilloscope. Differentially display the chopped signal. Determine, then note the peak-to-peak amplitude of the flat-field test signal.

c. Connect the FULL FIELD TEST signal to the PROGRAM LINE IN. Connect the PROGRAM LINE OUT to the test oscilloscope.

CHECK—PROGRAM LINE OUT signal amplitude should be within 1% of that noted in part b.

ADJUST—R765 (Prog Lum Gain) so that the PROGRAM LINE OUT signal amplitude is the same as noted in part b.

d. Connect the PREVIEW MONITOR to the test oscilloscope.

CHECK—PREVIEW MONITOR signal amplitude should be within 1% of that noted in part b.

ADJUST—R965 (Pre Lum Gain) so that the PREVIEW MONITOR signal amplitude is the same as noted in part b.

Check Waveform Tilt, Program and Preview

a. Connect the FULL FIELD TEST signal to the test oscilloscope. Connect the FULL FIELD SIG OUT to the test oscilloscope. Set the FULL FIELD SIG switch to SIN^2 PULSE AND BAR. Obtain a differential display and note any tilt (low frequency slope) of the 25 μs bar.

b. Connect the FULL FIELD TEST signal to the PROGRAM LINE IN. Connect the PROGRAM LINE OUT to the test oscilloscope.

CHECK—Tilt should be within 0.5% of that noted in part a (3.6 mV or less).

c. Connect the PREVIEW MONITOR OUT to the test oscilloscope.

CHECK—Tilt should be within 0.5% of that noted in part a (3.6 mV or less).

d. Connect the FULL FIELD TEST signal to the test oscilloscope. Set the FULL FIELD SIG switch to FIELD SQ WAVE. Obtain a differential display of the field square-wave signal and note any tilt error.

e. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN. Connect the PROGRAM LINE OUT to the test oscilloscope.

CHECK—Tilt change should be 3.6 mV or less (0.5%).

f. Connect the PREVIEW MONITOR OUT to the test oscilloscope.

CHECK—Tilt change should be 3.6 mV or less (0.5%), referenced to the full-field signal.

11. Check AUXILIARY PEDESTAL

a. Display the PREVIEW OUT signal on the monitor. Set the PROGRAM CONTROL switch to AUXILIARY.

CHECK—AUXILIARY PEDESTAL control range should be from 0 (or less) to 100 IRE (or more).

b. Connect a 0.1 to 0.5 V signal to the AUX IN input (the video signal source subcarrier signal via a X10 attenuator is acceptable).

CHECK—External signal rides on the auxiliary pedestal; it should not affect sync or VITS.

12. Check UNITY GAIN/VAR & LEVEL

Set the PROGRAM CONTROL switch to PROGRAM. Set the UNITY GAIN/VAR switch to VAR. Display the PROGRAM LINE OUT signal on the monitor.

CHECK—LEVEL control range should be from 70 IRE (or less) to 130 IRE (or more).

GROUP 15-TIMING

1. Check INSERT DELAY Range

a. Display the FULL FIELD TEST signal on the test oscilloscope. Select a reference point on the signal and vary the INSERT DELAY control.

CHECK—Range of control should be greater than 1 μs.

b. Leave the control at electrical center.

2. Check/Adjust Pulse Width

Observe the sync pulse.

CHECK—Timing accuracy as given below.

Fig. 4-36	Component	Timing
A	serration width	4.3 to 4.7 μs
B	sync width	4.65 to 4.75 μs
C	equalizer width	2.28 to 2.38 μs

ADJUST—Timing accuracy as given below.

Fig. 4-37	Timing
R350 (Serration Width)	4.5 μs
R250 (Sync Width)	4.71 μs
R150 (Equalizer Width)	2.33 μs

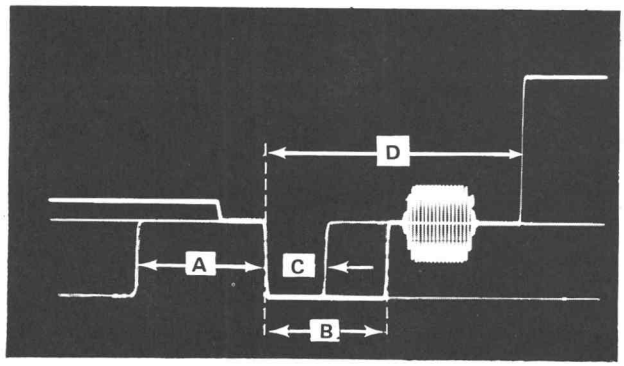


Fig. 4-36. Areas affected by timing adjustment.

3. Check/Adjust Sync Delay

a. Display the vertical interval of the PROGRAM LINE output signal on the test oscilloscope. INSERT DELAY control should be at electrical center. Observe the VIT signal sync pulse of noise, multiburst, or color bar.

CHECK—Timing, as shown in Fig. 4-36, should be 10 μs within 50 ns.

ADJUST—R1988 (Sync Delay), see Fig. 4-37, for 10 μs.

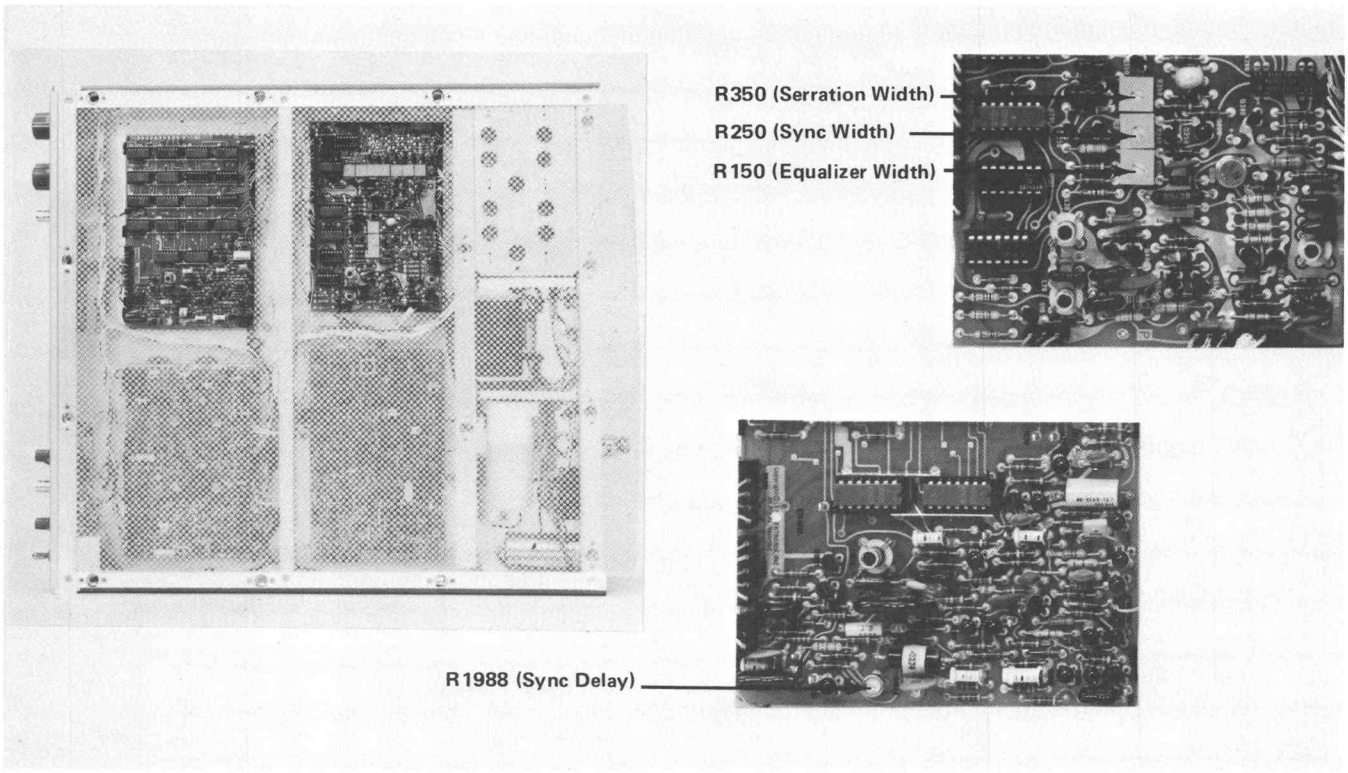


Fig. 4-37. Timing adjustment location.

GROUP 16-OPTIONAL CHECKS

This group of checks has been performed at the factory and may not be desired by the user.

1. POWER SUPPLY REGULATION

Requires a variable autotransformer.

Repeat the checks given in Group 1, Steps 1 and 2, while varying the autotransformer over the line voltage range listed for the LINE VOLTS selector switch position being used.

2. LINE 21 DELETE

Requires that the video signal source be capable of inserting a test signal on line 21 of both fields. The 149 needs to be programmed to verify the presence of the signal to be deleted.

Set the video signal source to insert a VITS on line 21 of both fields (it is easier to evaluate if the VITS is not the same as the full-field signal i.e., use staircase VITS and color bar full-field signal). Change the connector on P4200, located on the VITS Insertion board, to pins 1 and 2.

Display the vertical interval of the PROGRAM LINE OUT signal on the monitor and identify the VIT signal to be deleted. Change the connector on P4200 to pins 2 and 3. All of line 21, field 1 and half of line 21, field 2, should have been deleted.

3. RETURN LOSS

Requires a return loss bridge, constant amplitude signal generator and a minimum loss attenuator. See Test Equipment Used list, item 15. This is to be used in conjunction with the return loss bridge instruction manual.

a. Connect the composite video from the video signal source to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. Externally trigger the test oscilloscope from composite sync.

b. Balance the bridge.

c. Check return loss with the POWER switch OFF and the PROGRAM LINE OUT connector terminated with the return loss bridge termination.

CHECK—Return Loss should be at least –40 dB (7.9 mV) from 50 kHz to 6 MHz.

d. Turn the POWER switch ON.

CHECK—Return loss as follows:

PROGRAM LINE IN	–46 dB to 5 MHz
PROGRAM LINE OUT	–46 dB to 5 MHz
PREVIEW MONITOR (both)	–46 dB to 5 MHz
COMP SYNC	–46 dB to 3.6 MHz
FULL FIELD OUT (both)	–46 dB to 5 MHz
AUX IN	–46 dB to 5 MHz
EXT VIT INPUT	–34 dB to 5 MHz (10 mV)

4. EXT VITS GAIN

Requires the video signal source VITS amplitude be set to the full-field amplitude or the difference between the two noted. The 149 VITS Insertion board must be programmed to insert an external VITS. (See Operating Instructions; Operating Changes of this manual for details.)

a. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN. Connect the video signal source composite video to the BLACK BURST Input and loop-through to the EXT VITS IN connector. Set the SYNC SOURCE switch to BLACK BURST. Set the video signal source to insert a modulated staircase VITS on line 17 of field 2; program the 149 for this external VIT signal. Display the vertical interval of the PROGRAM LINE OUT signal on the monitor.

b. Adjust R7993 (Ext VITS Gain), see Fig. 4-33, to match the VIT signal amplitudes.

c. Display the PROGRAM LINE OUT signal on the vectorscope. Set the vectorscope to measure differential gain on line 17 of field 2.

CHECK—Diff Gain, should be 0.2% or less.

d. Set the vectorscope to measure differential phase.

CHECK—Diff Gain, should be 0.155° or less.

5. HARMONICS

Requires a spectrum analyzer. The spectrum analyzer may be used with an independent monitor or the test oscilloscope. When adjusting several parameters at the same time, the advantage is with the independent monitor. The

test oscilloscope requires several setup changes when changing from real-time amplitude measurements to spectrum analysis.

Refer to the spectrum analyzer instruction manual for setup information.

CHECK—All full-field signals should have a harmonic content requirement of –40 dB or greater.

6. APL Level and Staircase

a. Connect the FULL FIELD TEST signal to the test oscilloscope. Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to 0. Connect the chopper to the test oscilloscope. Differentially display the chopped signal on the test oscilloscope.

b. Check APL Levels. Set the chopper V_1 Range switch to 0 and the V_2 Range switch to 0. Check the 0 APL level for proper indexing. Set the APL switch to 10 and position the 10 APL level on the test oscilloscope CRT. Set the chopper V_2 Range switch to –1.1 V and adjust the chopper V_2 volts control so that the 10 APL level aligns with the blanking level.

CHECK—V_2 volts should be 70.0 to 73.0 mV. (10 APL level, 71.4 mV within 2%.)

c. Set the chopper V_1 range switch to +1.1 V. Use the following table to check the remaining APL levels.

NOTE

In the table below, read each line from left to right making all settings as listed. For example, the first line checks the 20 APL level as follows. Set the V_2 range switch to 0. Set the 1A5 position control to center. Adjust the V_1 volts control to align levels (if exact, it will be 71.4 mV). Set the 149 APL switch to 20. Set the V_2 range switch to –1.1 V. Set the 1A5 position control fully counterclockwise (↓). Check V_2 volts for 70.0 to 73.00 mV.

d. Using the method just described for checking the APL levels (part c) check the accuracy of the 5 Step and 10 Step staircase test signals.

CHECK—Amplitude of each riser is within 1% of each other.

7. PROGRAM LINE OUT

Requires an RMS voltmeter, a filter, and a weighting network. See Test Equipment Used list, items 12, 13, and 14. Step 7d also requires the use of a second 149, programmed to insert either a 2T Pulse or a color bar VIT signal.

a. Setup

Connect the video signal source composite video to the BLACK BURST input. Set the SYNC SOURCE switch to BLACK BURST. (There is no input to the PROGRAM LINE.) Display the PROGRAM LINE OUT signal on the test oscilloscope.

b. Check Residual Subcarrier

Set the PROGRAM CONTROL switch to PROGRAM.

CHECK—Residual subcarrier on lines 10 through 17 and on line 21, of both fields, should be 0.7 mV or less (60 dB).

APL	V_2 Range	1A5 Position	V_1 Volts To Match Levels	APL	V_2 Range	1A5 Position	V_2 Volts (Step Accuracy)
10	0	center	71.4 mV	20	–1.1	↓	70.0 - 73.0 mV
20	0	center	142.8 mV	30	–1.1	↓	70.0 - 73.0 mV
30	0	center	214.2 mV	40	–1.1	↓	70.0 - 73.0 mV
40	0	center	285.6 mV	50/50	–1.1	↓	70.0 - 73.0 mV
50	0	center	357.0 mV	60	–1.1	↓	70.0 - 73.0 mV
60	0	center	428.4mV	70	–1.1	↓	70.0 - 73.0 mV
70	0	center	499.88 mV	80	–1.1	↓	70.0 - 73.0 mV
80	0	center	571.2 mV	90	–1.1	↓	70.0 - 73.0 mV
90	0	center	642.0 mV	100	–1.1	↓	70.0 - 73.0 mV

CHECK—Set the PROGRAM CONTROL switch to PREVIEW; residual subcarrier on lines 10 through 21, of both fields, should be 0.7 mV or less (60 dB).

c. Check All Blanking Lines and Inactive Parts Of Lines

Connect a 5 MHz low pass filter between the cable and the 75 Ω termination to the test oscilloscope. View the entire vertical interval.

CHECK—Except for programmed VIT signals, there should be no signal greater than 7.0 mV (40 dB).

d. Check Active Part of Lines

Set the FULL FIELD SIG switch to FLAT FIELD and the APL switches to VARIABLE and 0. The 5 MHz low pass filter remains connected. Display the active portion (10 μs to 62 μs) of any line 22 through 262.

CHECK—Spurious coherent signals should be 0.7 mV or less (60 dB).

e. Check Delete Mode

The 5 MHz low pass filter remains connected.

CHECK—Active portion line 21, field 1, for signal attenuation as follows:

Any internal signal (rotate FULL FIELD SIG switch), –60 dB (0.7 mV or less);
2T Pulse (Pulse and Bar VITS from the second 149), –70 dB (0.222 mV or less);
Subcarrier (color bar VITS from the second 149) –60 dB (0.7 mV or less).

f. Check Non Inserted Lines

Connect (from the PROGRAM LINE OUT in listed order) a 75 Ω cable, 5 MHz weighting network, 5 MHz low pass filter, 75 Ω termination to the test oscilloscope. Trigger the test oscilloscope on the power input line.

CHECK—Power line transients and hum should be 0.7 mV or less (60 dB).

g. Check Random Noise Output

Terminate the PROGRAM LINE IN connector with a 75 Ω termination. Connect, (from the PROGRAM LINE OUT in listed order), a 75 Ω cable, 5 MHz weighting network, 5 MHz low pass filter, and a 75 Ω termination to the RMS voltmeter.

CAUTION

Check PREVIEW and AUXILIARY modes only. Program signals may damage the voltmeter.

CHECK—Random noise should be 0.14 mV RMS or less (75 dB).

NOTE

If the above requirement is not met, coherent noise (produced by a clamp pulse circuit) may be at fault. To eliminate the coherent noise remove Q820 (see diagram 0_a) and temporarily connect a 5 kΩ resistor between TP801 and ground while making the above check.

SECTION 5
RACKMOUNTING

RACKMOUNTING INSTRUCTIONS

Mounting Methods (Figs. 5-1, 5-2, 5-5 and 5-6)

The instruments will fit most commercial consoles and most 19-inch wide racks whose front and rear rail holes conform to Universal, EIA, RETMA and Western Electric hole spacing.

Fig. 5-1 shows the instrument installed in a cabinet type rack with 1 3/4-inch wide slide-out tracks for a non-tilt installation. The instrument is secured into the rack by means of four captive thumb screws. When the thumb screws on the front panel are loosened, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 5-2). This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack.

The slide-out tracks easily mount to the cabinet rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10 1/2 to 24 1/2 inches. Some means of support (for example, make extensions for the rear mounting brackets) is needed for the rear ends of the slide-out tracks if the tracks are going to be installed in a cabinet rack whose inside dimension between front and rear rails is not the proper distance (10 1/2 inches to 24 1/2 inches).

Instrument Dimension

The last page in this section shows dimensional drawings exclusive of the power cord and cables.

Width—A standard 19-inch rack may be used. The dimension or opening between the front rails must be at least 17 5/8 inches (see Fig. 5-2) for a cabinet rack in which the front lip of the stationary section is mounted behind an untapped front rail as shown in the right-hand illustration of Fig. 5-6. This dimension allows room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

Depth—For proper circulation of cooling air, allow at least 2 inches clearance behind the rear of the instrument and any enclosure on the rack (see dimensional drawing). If it is sometimes necessary or desirable to operate the generator in the fully extended position, use cables that are long enough to reach from the instrument to the location where the signal(s) is to be applied.

Rackmounting in a Cabinet Rack

General Information—The slide-out-tracks for the instrument consists of two assemblies, one for the left side of the instrument and one for the right side. Each assembly consists of three sections as illustrated in Fig. 5-3. The stationary section attaches to the front and rear rails of the rack with inside dimensions as indicated in Fig. 5-2; the chassis section attaches to the instrument and is installed at the factory; the intermediate section fits between the other two sections to allow the instrument to be fully extended out of the rack.

The small hardware components included with the slide-out track assemblies are shown in Fig. 5-4. The hardward shown in Fig. 5-4 is used to mount the slide-out tracks to the rack rails having this compatibility.

(a) Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting holes (see Fig. 5-6).

(b) Front rail holes may have already been countersunk prior to this installation.

Because of the compatibility given in (b), there will be some screws left over.

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets for both sides including hardware are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop are located near the top of the matched sets when they are properly mated to the chassis sections as shown in Fig. 5-3.

Mounting Procedure—Use the following procedure to mount both sets. See Fig. 5-5 and 5-6 for installation details.

1. To mount the instrument directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 5-5 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front rails are not countersunk, use the pan head screws and bar nuts to mount the stationary sections similar to the right-hand illustration shown in Fig. 5-6.

(b) If the front rails are countersunk, use the flat head screws and bar nuts to mount the stationary sections as shown in Fig. 5-6 right-hand illustration.

3. Mount the stationary slide-out track sections to the non-tapped rear rails using this method:

Mount the left stationary section with hardware provided as shown in the left-hand or center illustration in Fig. 5-6. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 5-6 as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

Adjustments

To adjust the slide-out tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as described and as shown in steps 1 through 4 of Fig. 5-7 installation procedure.

2. Adjust the slide-out tracks for proper spacing as shown in Fig. 5-8.

Maintenance

The slide-out tracks require no lubrication. The special dark gray finish on the sliding parts is a permanent lubrication.

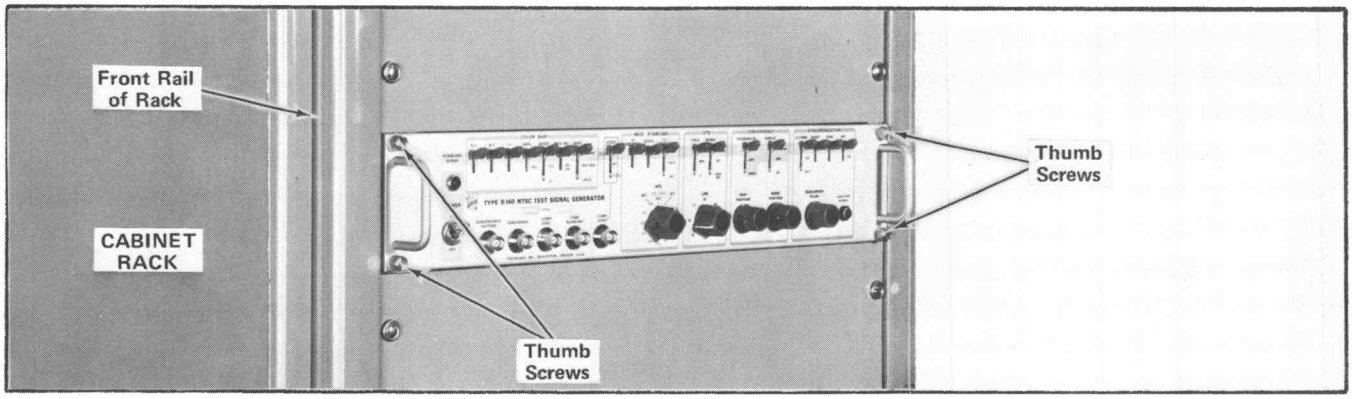


Fig. 5-1. The generator installed in a cabinet rack.

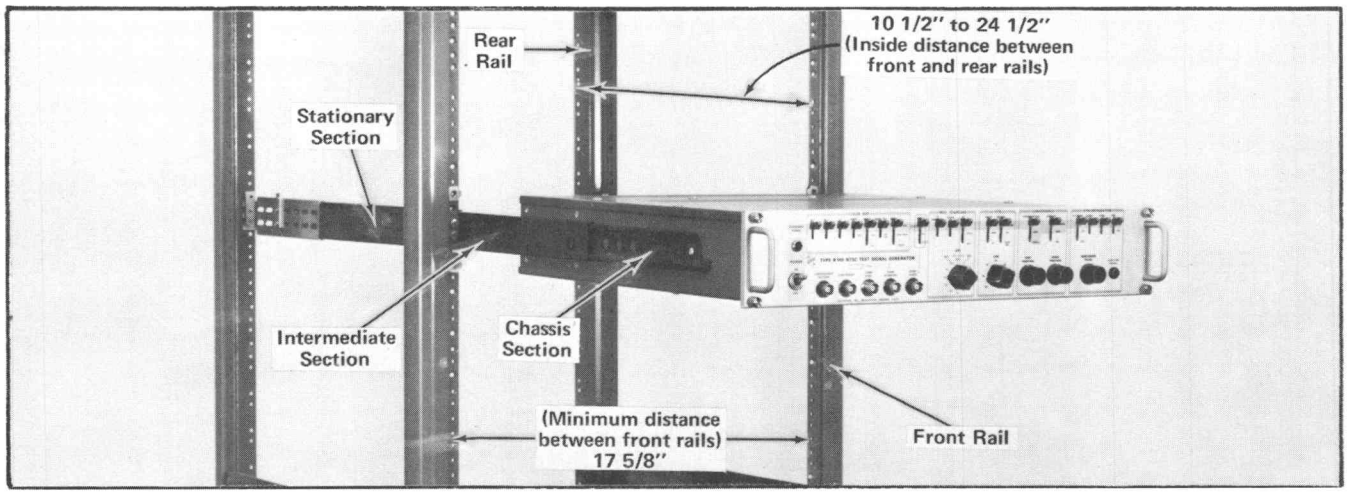


Fig. 5-2. The generator shown in the fully extended position. The cabinet rack sides have been removed from the rack to show mounting.

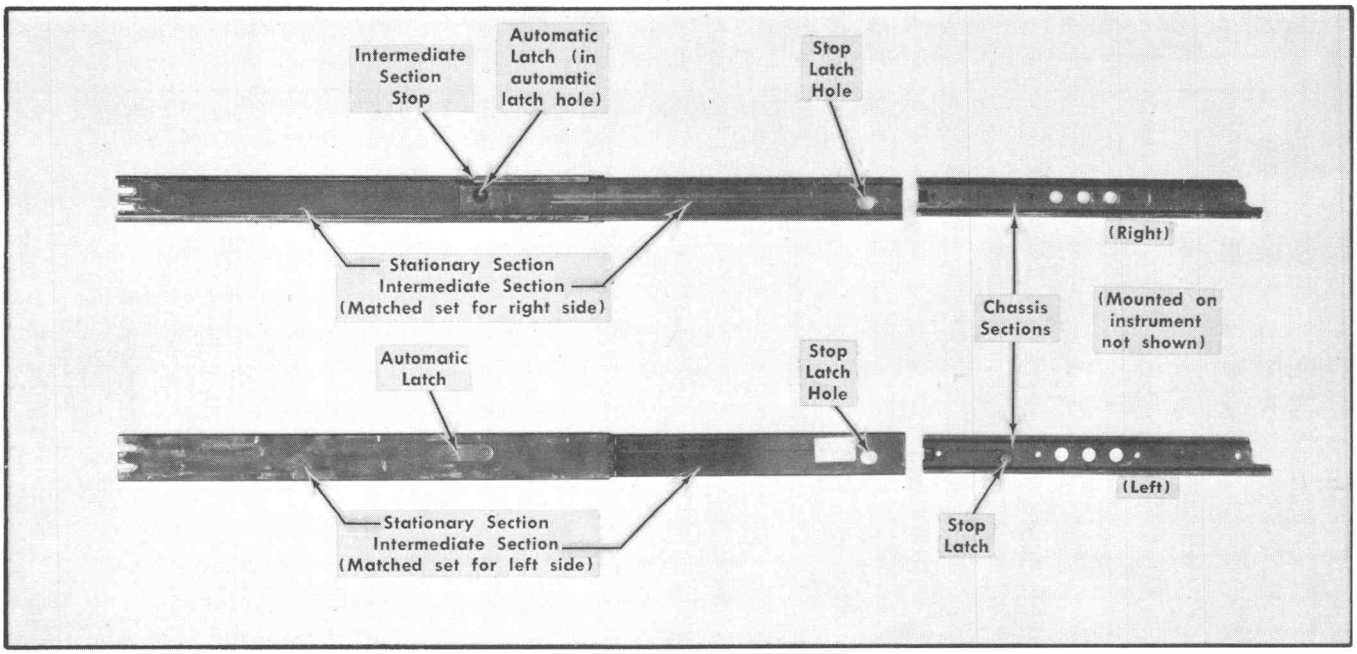


Fig. 5-3. Illustration showing the 1 3/4-inch wide slide-out track assemblies.

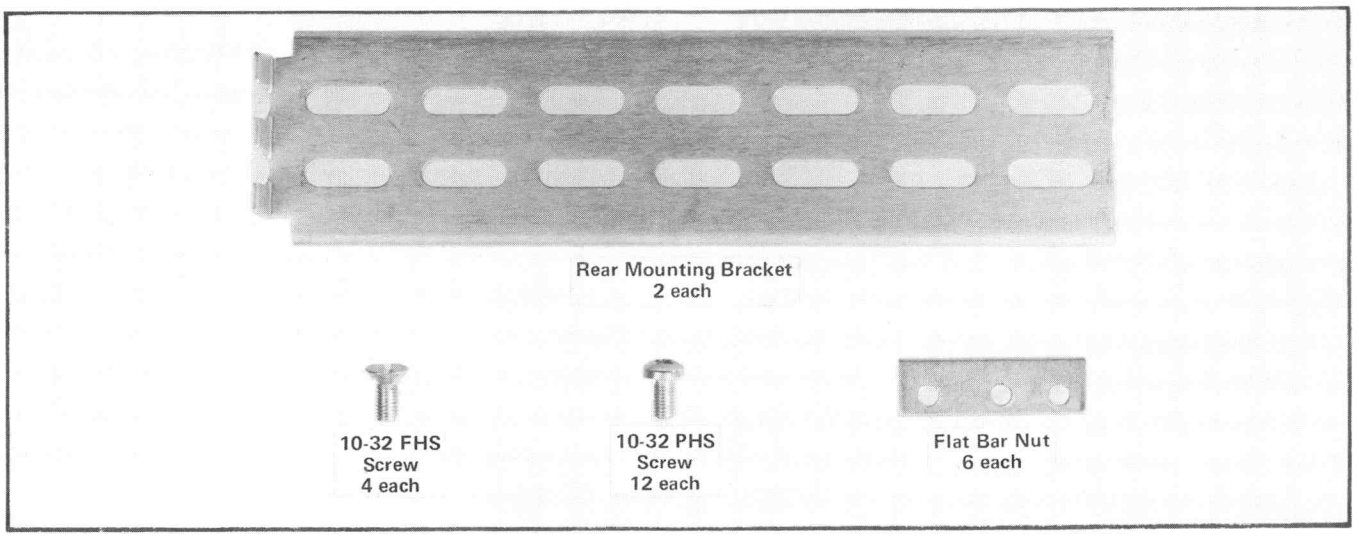


Fig. 5-4. Small hardware components for mounting the stationary sections to the rack rails.

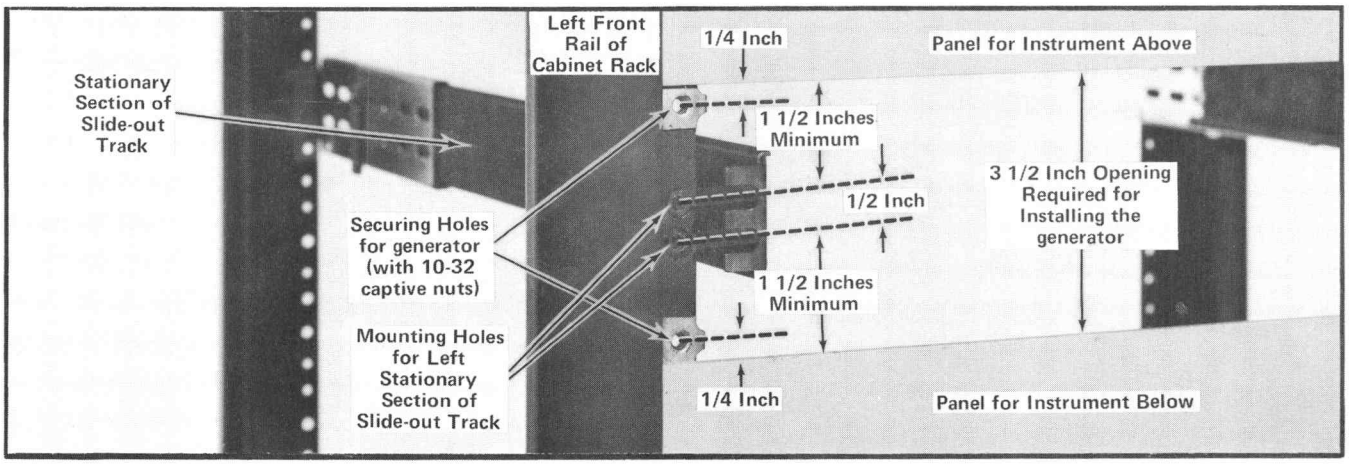


Fig. 5-5. Vertical mounting position of the left stationary section and location of the securing holes. These same dimensions apply to the right front rail.

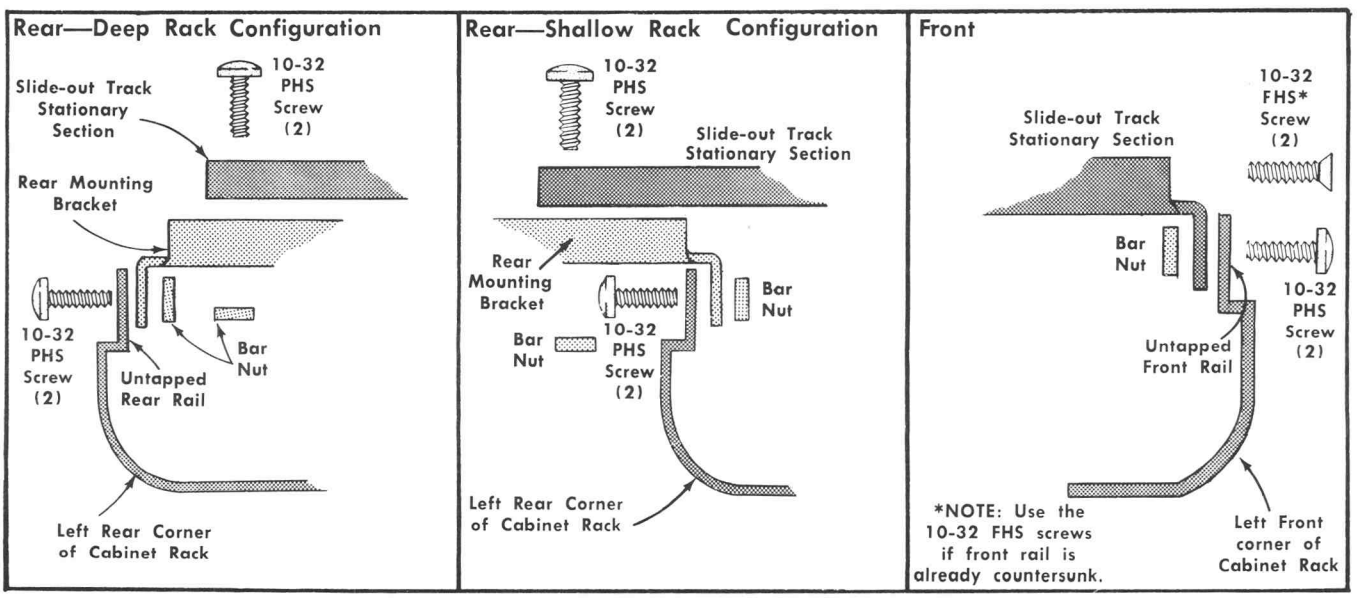


Fig. 5-6. Top view of cabinet rack showing mounting position of the left stationary section to the rails of the rack. Since the rails are not tapped, bar nuts are used to mount the stationary section to the rack rails.

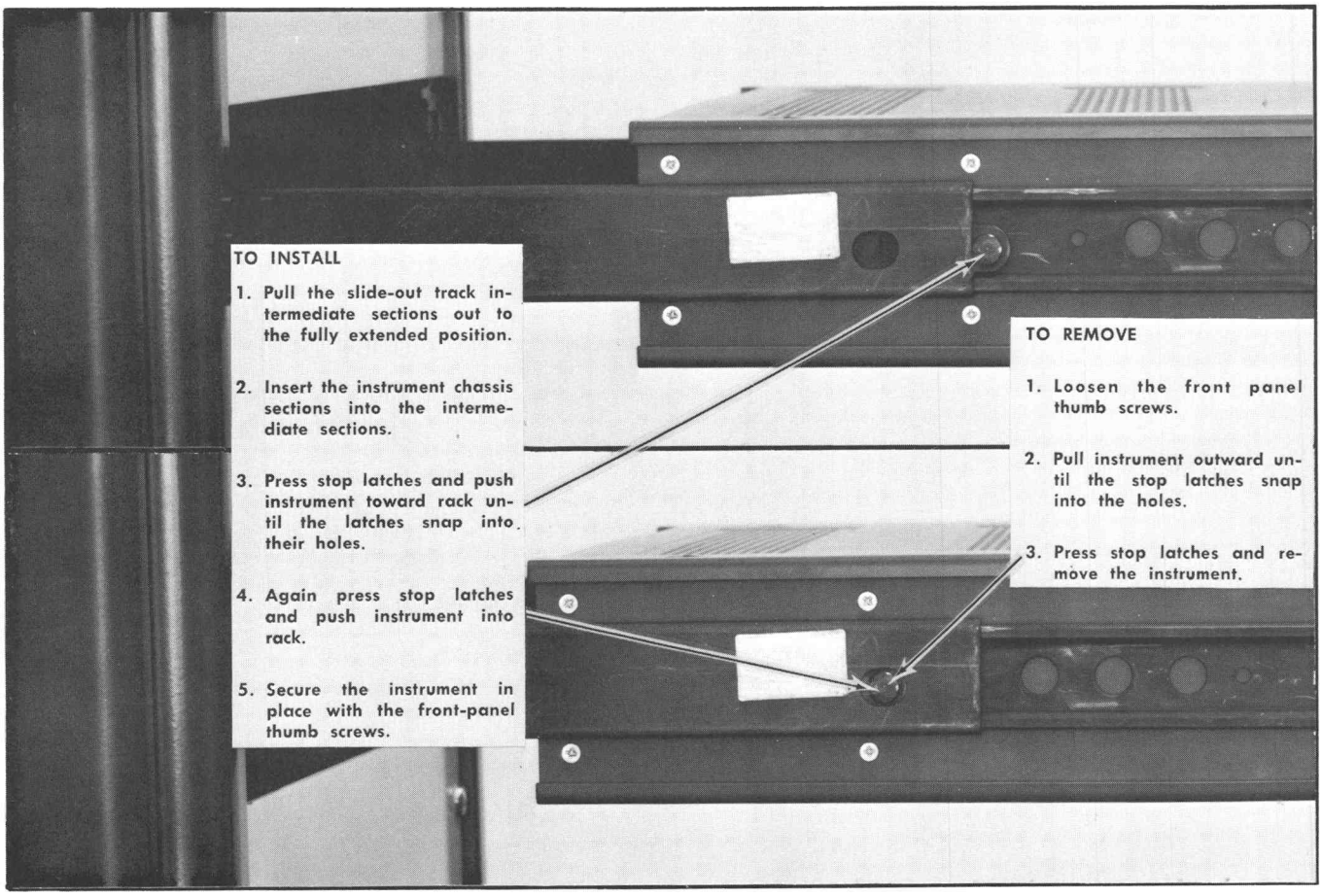


Fig. 5-7. Installing and removing the instrument.

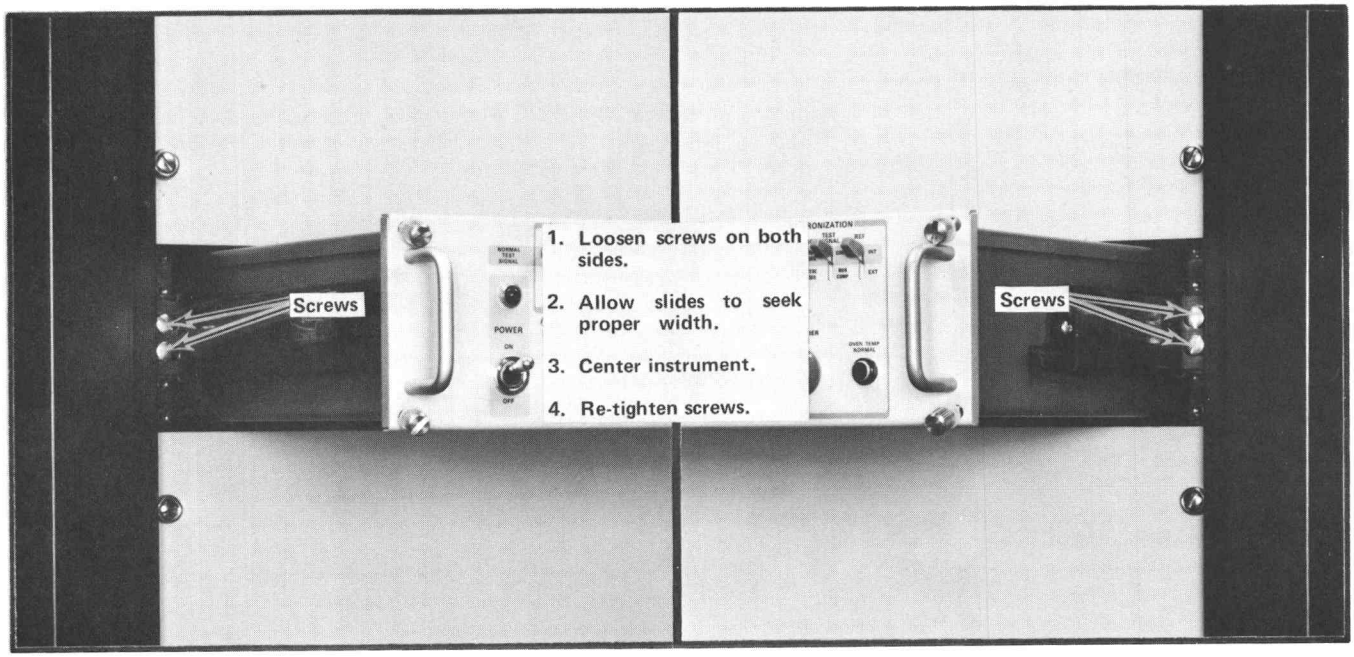
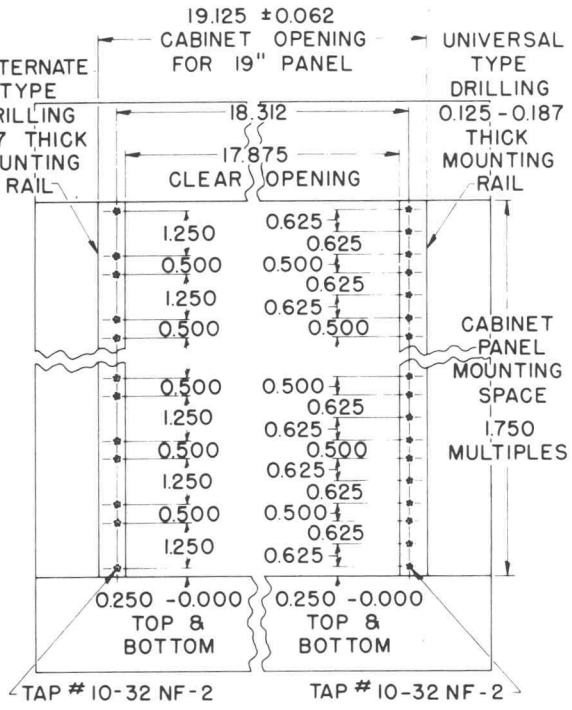
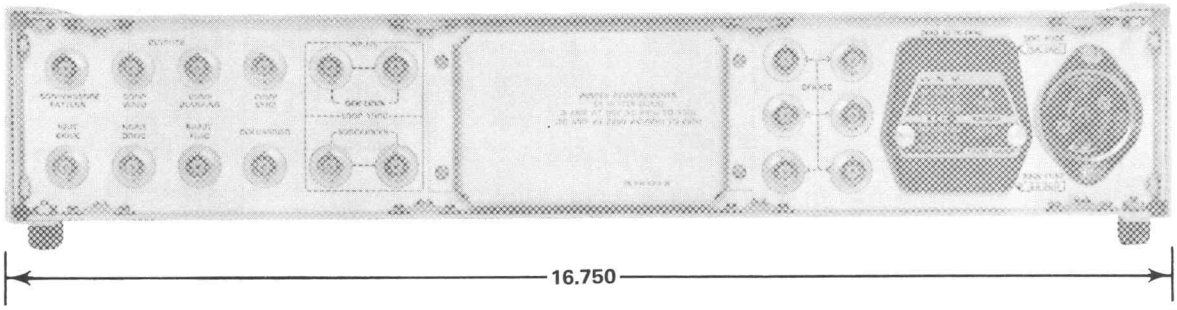
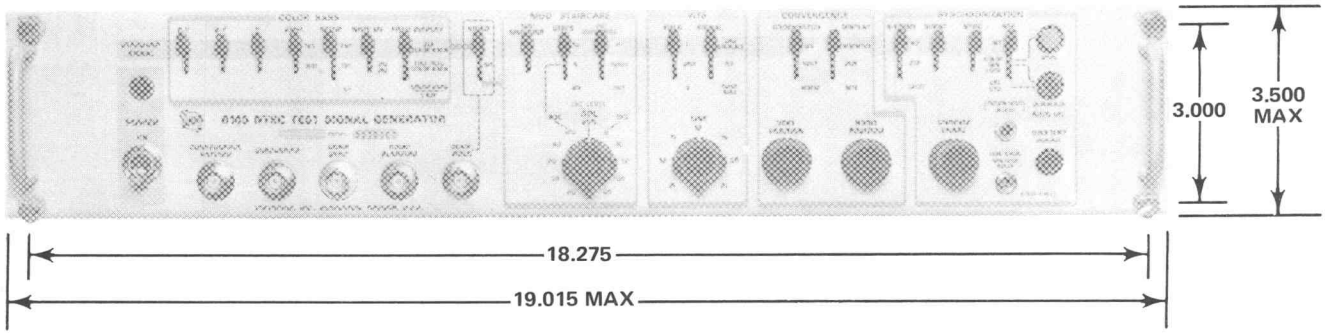


Fig. 5-8. Adjusting the slide-out tracks for smooth sliding action.

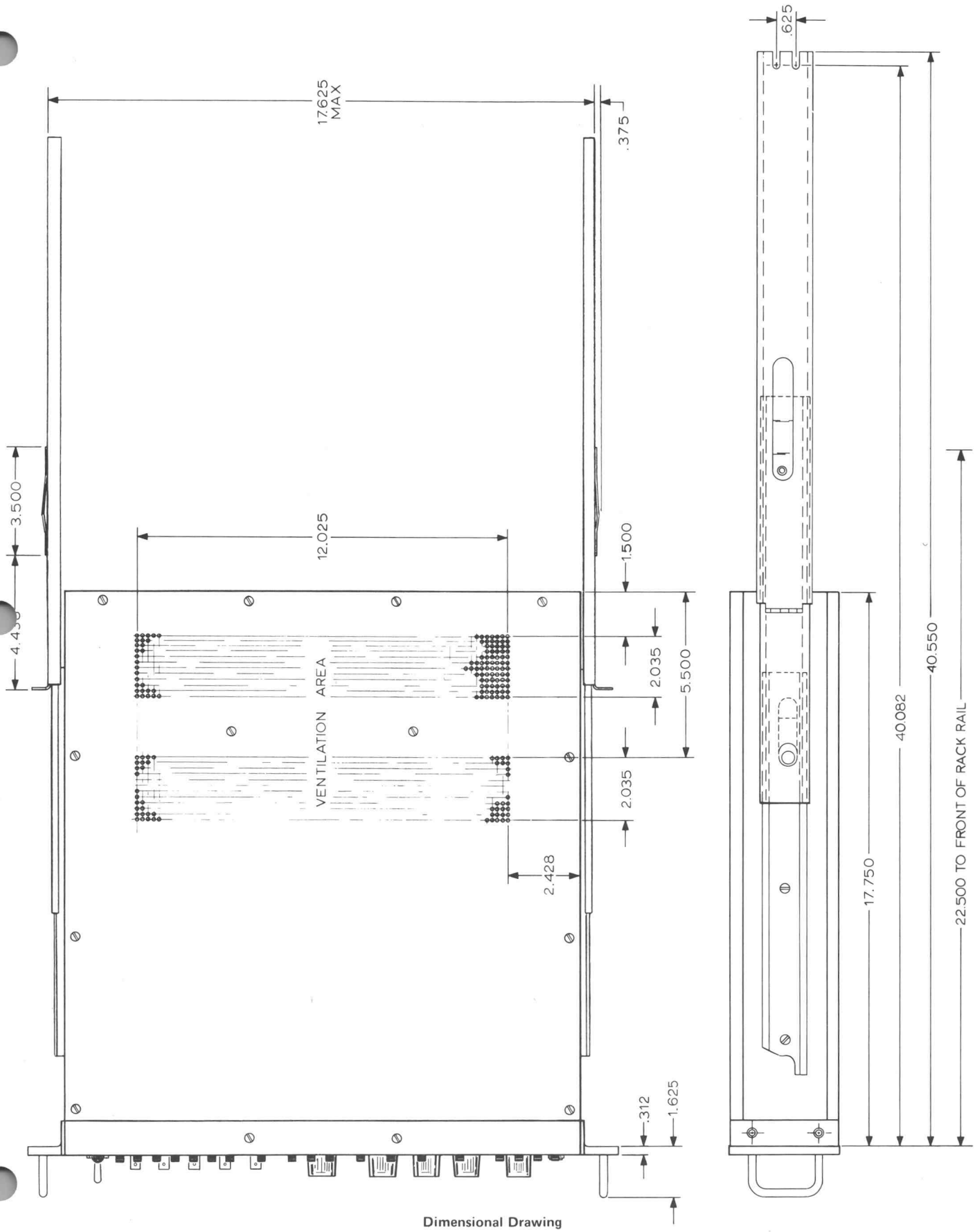
RACK RAIL TYPES







Dimensional Drawing



Dimensional Drawing

SECTION 6
ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL	Filter	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable	H	Heat dissipating device (heat sink, etc.)	R	Resistor, fixed or variable
B	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or non-repairable
CRT	cathode-ray tube	M	Meter	V	Electron tube
DL	Delay line	Q	Transistor or silicon-controlled rectifier	Var	Variable
DS	Indicating device (lamp)	P	Connector, movable portion	VR	Voltage regulator (zener diode, etc.)
Elect.	Electrolytic	PMC	Paper, metal cased	WW	wire-wound
EMC	electrolytic, metal cased	PT	paper, tubular	Y	Crystal
EMT	electrolytic, metal tubular				
F	Fuse				

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLIES				
A0	670-1468-01			VIT INSERTION Circuit Board Assembly
A1	670-1472-00			VERT COUNTER Circuit Board Assembly
A2	670-2040-00			HORIZ TIMING Circuit Board Assembly
A3	670-2349-00			APL STAIRCASE & COLOR BAR Circuit Board Assy
A4	670-1469-00			VIT FULL FIELD Circuit Board Assembly
A5	670-1487-00			GENLOCK Circuit Board Assembly
A6	670-2039-01			FUNCTION GEN Circuit Board Assembly
A7	670-2042-01			OUTPUT AMP Circuit Board Assembly
A8	670-2351-00			MODULATOR Circuit Board Assembly
A9	670-2350-00			SUBCARRIER SYNC Circuit Board Assembly
A10	670-1473-01			POWER SUPPLY Circuit Board Assembly
A11	670-2327-00			RELAY Circuit Board Assembly
CAPACITORS				
C22	283-0596-00			528 pF, Mica, 300 V, 1%
C24	283-0602-00			53 pF, Mica, 300 V, 5%
C28	283-0625-00			220 pF, Mica, 500 V, 1%
C30	283-0632-00			87 pF, Mica 100 V, 1%
C50	283-0178-00			0.1 uF, Cer, 100 V, +80%-20%
C53	283-0004-00			0.02 uF, Cer, 150 V
C55	290-0527-00			15 uF, Elect., 20 V, 20%
C64	283-0239-00			0.022 uF, Cer, 50 V, 10%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C80	283-0004-00			0.02 µF, Cer, 150 V
C90	283-0641-00			180 pF, Mica, 100 V, 1%
C94	283-0641-00			180 pF, Mica, 100 V, 1%
C101	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C130	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C150	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C180	283-0239-00			0.022 µF, Cer, 50 V, 10%
C185	290-0527-00			15 µF, Elect., 20 V, 20%
C260	290-0527-00			15 µF, Elect., 20 V, 20%
C330	283-0594-00			0.001 µF, Mica, 100 V, 1%
C335	283-0594-00			0.001 µF, Mica, 100 V, 1%
C340	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C354	290-0529-00			47 µF, Elect., 20 V, 20%
C403	283-0597-00			470 pF, Mica, 300 V, 10%
C404	283-0596-00			528 pF, Mica, 300 V, 1%
C406	283-0598-00			253 pF, Mica, 300 V, 5%
C410	283-0004-00			0.02 µF, Cer, 150 V
C438	283-0647-00			70 pF, Mica, 100 V, 1%
C440	283-0647-00			70 pF, Mica, 100 V, 1%
C448	283-0597-00			470 pF, Mica, 300 V, 10%
C460	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C471	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C472	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C481	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C488	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C513	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C514	283-0194-00			4.7 µF, Cer, 50 V, 20%
C520	290-0367-00			70 µF, Elect., 6 V, 20%
C537	281-0659-00			4.3 pF, Cer, 500 V, ±0.25 pF
C558	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C565	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C580	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C593	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C595	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C596	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C597	283-0660-00	XB020000		510 pF, Mica, 500 V, 2%
C610	283-0194-00			4.7 uF, Cer, 50 V, 20%
C614	290-0519-00			100 µF, Elect., 20 V, 20%
C620	283-0047-00			270 pF, Cer, 500 V, 5%
C628	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C650	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C692	290-0530-00			68 µF, Elect., 6 V, 20%
C693	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C694	290-0527-00			15 µF, Elect., 20 V, 20%
C695	281-0523-00			100 pF, Cer, 350 V, 20%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C696	283-0599-00			98 pF, Mica, 500 V, 5%
C718	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C749	281-0153-00			1.7-10 pF, Var, Air, 250 V
C779	281-0153-00			1.7-10 pF, Var, Air, 250 V
C790	290-0526-00			6.8 µF, Elect., 20%
C804	285-0622-00			0.1 µF, Plastic, 100 V, 20%
C822	283-0001-00			0.005 µF, Cer, 500 V
C844	283-0134-00			0.47 µF, Cer, 50 V, +80-20%
C849	281-0153-00			1.7-10 pF, Var, Air, 250 V
C865	283-0648-00			10 pF, (nominal value), selected
C879	281-0153-00			1.7-10 pF, Var, Air, 250 V
C898	290-0526-00			6.8 µF, Elect., 20%
C910	281-0523-00			100 pF, Cer, 350 V, 20%
C915	283-0644-00			150 pF, Mica, 500 V, 1%
C918	283-0644-00			150 pF, Mica, 500 V, 1%
C919	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C927	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C929	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C959	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C968	283-0672-00			200 pF, Mica, 500 V, 1%
C978	281-0541-00			6.8 pF, (nominal value), selected
C989	283-0194-00			4.7 µF, Cer, 50 V, 20%
C990	281-0523-00			100 pF, Cer, 350 V, 20%
C998	290-0135-00			15 µF, Elect., 20 V, 20%
C1000	283-0167-00			0.1 µF, Cer, 100 V, 10%
C1401	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1460	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1501	285-0835-00			0.22 µF, PTM, 100 V, 2%
C1515	281-0580-00			470 pF, Cer, 500 V, 10%
C1601	283-0058-00			0.027 µF, Cer, 100 V, 10%
C1650	281-0580-00			470 pF, Cer, 500 V, 10%
C1701	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1720	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1730	283-0004-00			0.02 µF, Cer, 150 V
C1755	283-0641-00			180 pF, Mica, 100 V, 1%
C1760	283-0167-00			0.1 µF, Cer, 100 V, 10%
C1770	283-0593-00			0.01 µF, Mica, 100 V, 1%
C1780	285-0626-00			0.0015 µF, PTM, 100 V, 10%
C1798	283-0594-00			0.001 µF, Mica, 100 V, 1%
C1895	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1902	283-0622-00			450 pF, Mica, 300 V, 1%
C1930	281-0629-00			33 pF, Cer, 600 V, 5%
C1940	281-0546-00			330 pF, Cer, 500 V, 10%
C1950	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1995	281-0562-00			39 pF, Cer, 500 V
C1998	283-0593-00			0.01 µF, Mica, 100 V, 1%
C2030	290-0531-00			100 µF, Elect., 10 V, 20%
C2722	283-0594-00			0.001 µF, Mica, 100 V, 1%
C2810	283-0032-00			470 pF, Cer, 500 V, 5%
C2929	283-0032-00			470 pF, Cer, 500 V, 5%
C2936	283-0032-00			470 pF, Cer, 500 V, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C2958	283-0032-00			470 pF, Cer, 500 V, 5%
C3126	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C3359	283-0642-00			33 pF, Mica, 300 V, ±0.5 pF
C3421	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C3431	290-0534-00			1 µF, Elect., 35 V, 20%
C3441	283-0645-00			790 pF, Mica, 100 V, 1%
C3443	283-0645-00			790 pF, Mica, 100 V, 1%
C3461	283-0634-00			65 pF, Mica, 100 V, 1%
C3467	283-0637-00			20 pF, Mica, 100 V, ±0.5 pF
C3470	281-0131-00			2.4-24.5 pF, Var, Air, 250 V
C3473	283-0638-00			130 pF, Mica, 100 V, 1%
C3491	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C3551	283-0004-00			0.02 µF, Cer, 150 V
C3565	281-0131-00			2.4-24.5 pF, Var, Air, 250 V
C3601	290-0534-00			1 µF, Elect., 35 V, 20%
C3651	283-0004-00			0.02 µF, Cer, 150 V
C3881	290-0527-00			15 µF, Elect., 20 V, 20%
C5022	283-0110-00			0.005 µF, Cer, 150 V
C5040	283-0111-00			0.1 µF, Cer, 50 V
C5042	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5048	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C5049	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5050	283-0256-00			130 pF, Cer, 100 V, 5%
C5065	290-0114-00			47 µF, Elect., 6 V
C5070	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5085	290-0134-00			22 µF, Elect., 15 V, 20%
C5120	283-0256-00			130 pF, Cer, 100 V, 5%
C5141	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5170	283-0004-00			0.02 µF, Cer, 150 V
C5201	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5210	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5225	283-0111-00			0.1 µF, Cer, 50 V
C5245	283-0192-00			0.47 µF, Cer, 3 V, +80%-20%
C5258	283-0596-00			528 pF, Mica, 300 V, 1%
C5270	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C5291	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5330	283-0023-00			0.1 µF, Cer, 10 V, +80%-20%
C5335	283-0032-00			470 pF, Cer, 500 V, 5%
C5342	283-0032-00			470 pF, Cer, 500 V, 5%
C5362	283-0004-00			0.02 µF, Cer, 150 V
C5410	283-0023-00			0.1 µF, Cer, 10 V, +80-20%
C5435	283-0192-00			0.47 µF, Cer, 3 V, +80%-20%
C5450	283-0104-00			2000 pF, Cer, 500 V, 5%
C5468	283-0004-00			0.02 µF, Cer, 150 V
C5518	283-0032-00			470 pF, Cer, 500 V, 5%
C5540	283-0104-00			2000 pF, Cer, 500 V, 5%
C5568	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5570	283-0017-00			1 µF, Cer, 3 V
C5572	283-0004-00			0.02 µF, Cer, 150 V
C5615	283-0618-00			130 pF, Mica, 300 V, 2%
C5620	283-0618-00			130 pF, Mica, 300 V, 2%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C5622	283-0004-00			0.02 µF, Cer, 150 V
C5648	283-0004-00			0.02 µF, Cer, 150 V
C5660	283-0004-00			0.02 µF, Cer, 150 V
C5665	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5670	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5715	283-0004-00			0.02 µF, Cer, 150 V
C5718	281-0503-00			8 pF, Cer, 500 V, ±0.5 pF
C5720	283-0004-00			0.02 µF, Cer, 150 V
C5750	283-0032-00			470 pF, Cer, 500 V, 5%
C5775	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5788	283-0079-00			0.01 µF, Cer, 250 V, 20%
C5799	283-0079-00			0.01 µF, Cer, 250 V, 20%
C5810	283-0004-00			0.02 µF, Cer, 150 V
C5820	283-0651-00			430 pF, Mica, 500 V, 1%
C5824	283-0119-00			220 pF, Cer, 200 V, 5%
C5826	283-0032-00			470 pF, Cer, 500 V, 5%
C5834	283-0004-00			0.02 µF, Cer, 150 V
C5840	283-0615-00			33 pF, Mica, 500 V, 5%
C5850	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5862	290-0415-00			5.6 µF, Elect., 35 V, 10%
C4188	283-0111-00			0.1 µF, Cer, 50 V
C4460	283-0032-00			470 pF, Cer, 500 V, 5%
C4620	283-0111-00			0.1 µF, Cer, 50 V ,
C6042	281-0613-00			10 pF, Cer, 200 V, 10%
C6047	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C6051	290-0523-00			2.2 µF, Elect., 20 V, 20%
C6071	283-0615-00			33 pF, Mica, 500 V, 5%
C6078	283-0644-00			150 pF, Mica, 500 V, 1%
C6108	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C6362	283-0004-00			0.02 µF, Cer, 150 V
C6372	283-0198-00			0.22 µF, Cer, 50 V, 20%
C6382	283-0635-00			51 pF, Mica, 100 V, 1%
C6486	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C6508	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C6533	283-0648-00			10 pF, Moca, 100 V, ±0.5 pF
C6562	281-0510-00			22 pF, Cer, 500 V, 20%
C6606	283-0004-00			0.02 µF, Cer, 150 V
C6614	290-0530-00			68 µF, Elect., 6 V, 20%
C6663	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C6665	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C6682	283-0004-00			0.02 µF, Cer, 150 V
C6693	281-0153-00			1.7-10 pF, Var, Air, 250 V
C6712	290-0530-00			68 µF, Elect., 6 V, 20%
C6736	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C6748	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C6763	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C6788	281-0153-00			1.7-10 pF, Var, Air, 250 V
C6844	281-0611-00			2.7 pF, (nominal value), selected
C6866	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C6887	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C6979	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C7061	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C7212	283-0634-00			65 pF, Mica, 100 V, 1%
C7301	283-0630-00			110 pF, (nominal value), selected
C7303	283-0640-00			160 pF, Mica, 100 V, 1%
C7305	283-0649-00			105 pF, (nominal value), selected
C7307	283-0596-00			528 pF, Mica, 300 V, 1%
C7309	283-0636-00			36 pF, Mica, 100 V, ±0.5 pF
C7310	283-0633-00			77 pF, Mica, 100 V, 1%
C7311	283-0649-00			105 pF, Mica, 300 V, 1%
C7312	283-0644-00			150 pF, Mica, 500 V, 1%
C7383	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C7401	283-0639-00			56 pF, Mica, 100 V, 1%
C7403	283-0603-00			113 pF, Mica, 300 V, 2%
C7431	283-0004-00			0.02 µF, Cer, 150 V
C7451	283-0111-00			0.1 µF, Cer, 50 V
C7461	281-0166-00			1.9-15.7 pF, Var, Air, 250 V
C7463	281-0166-00			1.9-15.7 pF, Var, Air, 250 V
C7481	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C7501	283-0636-00			36 pF, Mica, 100 V, ±0.5 pF
C7503	283-0674-00			85 pF, Mica, 500 V, 1%
C7505	283-0601-00			22 pF, Mica, 300 V, 10%
C7507	283-0600-00			43 pF, Mica, 500 V, 5%
C7508	283-0639-00			56 pF, Mica, 100 V, 1%
C7509	283-0638-00			130 pF, Mica, 100 V, 1%
C7533	283-0635-00			51 pF, Mica, 100 V, 1%
C7555	283-0598-00			253 pF, Mica, 300 V, 5%
C7601	283-0601-00			22 pF, Mica, 300 V, 10%
C7603	283-0635-00			51 pF, Mica, 100 V, 1%
C7671	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C7711	290-0524-00			4.7 µF, Elect., 10 V, 20%
C7731	283-0644-00			150 pF, Mica, 500 V, 1%
C7781	283-0111-00			0.1 µF, Cer, 50 V
C7783	290-0529-00			47 µF, Elect., 20 V, 20%
C7791	281-0661-00			0.8 pF, Cer, 500 V, 10%
C7801	281-0626-00			3.3 pF, Cer, 500 V, 5%
C7803	283-0598-00			253 pF, Mica, 300 V, 5%
C7861	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C7883	283-0111-00			0.1 µF, Cer, 50 V
C7891	283-0633-00			77 pF, Mica, 100 V, 1%
C7901	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C7903	290-0517-00			6.8 µF, Elect., 35 V, 20%
C7932	283-0164-00			2.2 µF, Cer, 25 V, 20%
C7951	283-0111-00			0.1 µF, Cer, 50 V
C8031	290-0246-00			3.3 µF, Elect., 15 V, 10%
C8051	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8051	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8101	283-0104-00			2000 pF, Cer, 500 V, 5%
C8131	283-0003-00	B010100	B010150	0.01 µF, Cer, 150 V, +80%-20%
C8131	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C8179	283-0618-00			130 pF, Mica, 300 V, 2%
C8285	283-0643-00			22 pF, Mica, 300 V, ±0.5 pF
C8307	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C8351	283-0598-00			253 pF, Mica, 300 V, 5%
C8359	283-0003-00	B010100	B010150	0.01 µF, Cer, 150 V, +80%-20%
C8359	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8403	283-0630-00			110 pF, Mica, 100 V, 1%
C8427	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C8435	283-0649-00			105 pF, Mica, 300 V, 1%
C8459	283-0598-00			253 pF, Mica, 300 V, 5%
C8477	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C8481	283-0178-00			0.1 µF, Cer, 100 V, +80%-20%
C8503	283-0647-00			70 pF, Mica, 100 V, 1%
C8505	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C8527	283-0615-00			33 pF, Mica, 500 V, 5%
C8529	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C8533	283-0084-00			270 pF, Cer, 1000 V, 5%
C8535	283-0639-00			56 pF, Mica, 100 V, 1%
C8587	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8587	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8627	283-0630-00			110 pF, Mica, 100 V, 1%
C8653	283-0084-00			270 pF, Cer, 1000 V, 5%
C8657	283-0084-00			270 pF, Cer, 1000 V, 5%
C8659	283-0084-00			270 pF, Cer, 1000 V, 5%
C8665	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8665	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8677	281-0116-00			1.6-9.1 pF, Var, Air
C8685	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8685	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8729	283-0687-00			560 pF, Mica, 300 V, 2%
C8733	283-0600-00			43 pF, Mica, 500 V, 5%
C8751	283-0084-00			270 pF, Cer, 1000 V, 5%
C8757	283-0084-00			270 pF, Cer, 1000 V, 5%
C8787	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8787	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8791	283-0003-00	B010100	B010150	0.01 µF, Cer, 150 V, +80%-20%
C8791	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8827	283-0004-00	B010100	B010150	0.01 µF, Cer, 150 V
C8827	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8845	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8845	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8881	283-0003-00	B010100	B010150	0.01 µF, Cer, 150 V, +80%-20%
C8881	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8901	283-0134-00			0.47 µF, Cer, 50 V, +80%-20%
C8903	283-0054-00			150 pF, Cer, 200 V, 5%
C8933	283-0004-00	B010100	B010150	0.02 µF, Cer, 150 V
C8933	283-0198-00	B010151		0.22 µF, Cer, 50 V, 20%
C8935	283-0004-00			0.02 µF, Cer, 150 V
C9011	290-0334-00			1250 µF, Elect., 50 V, +75%-10%
C9042	290-0321-00			11000 µF, Elect., 15 V, +100%-0%
C9061	290-0086-00			2000 µF, Elect., 30 V
C9082	283-0003-00			0.01 µF, Cer, 150 V
C9084	283-0003-00			0.01 µF, Cer, 150 V
C9086	283-0003-00			0.01 µF, Cer, 150 V
C9088	281-0625-00			35 pF, Cer, 500 V, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C9215	283-0111-00			0.1 µF, Cer, 50 V
C9218	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C9802	285-0598-00			0.01 µF, PTM, 100 V, 5%
C9810	283-0026-00			0.2 µF, Cer, 25 V, +80%-20%
C9824	290-0296-00			100 µF, Elect., 20 V, 20%
C9830	285-0598-00			0.01 µF, PTM, 100 V, 5%
C9831	290-0135-00			15 µF, Elect., 20 V, 20%
C9832	283-0026-00			0.2 µF, Cer, 25 V, +80%-20%
C9850	290-0135-00			15 µF, Elect., 20 V, 20%
C9852	283-0026-00			0.2 µF, Cer, 25 V, +80%-20%
C9854	281-0549-00			68 pF, Cer, 500 V, 10%
C9856	285-0598-00			0.01 µF, PTM, 100 V, 5%
DIODES				
CR7	152-0141-02			Silicon, replaceable by 1N4152
CR8	152-0141-02			Silicon, replaceable by 1N4152
CR35	152-0141-02			Silicon, replaceable by 1N4152
CR250	152-0141-02			Silicon, replaceable by 1N4152
CR329	152-0141-02			Silicon, replaceable by 1N4152
CR338	152-0141-02			Silicon, replaceable by 1N4152
CR456	152-0141-02			Silicon, replaceable by 1N4152
CR460	152-0141-02			Silicon, replaceable by 1N4152
CR469	152-0141-02			Silicon, replaceable by 1N4152
CR476	152-0141-02			Silicon, replaceable by 1N4152
CR477	152-0141-02			Silicon, replaceable by 1N4152
CR478	152-0141-02			Silicon, replaceable by 1N4152
CR479	152-0141-02			Silicon, replaceable by 1N4152
CR480	152-0141-02			Silicon, replaceable by 1N4152
CR485	152-0141-02			Silicon, replaceable by 1N4152
CR487	152-0141-02			Silicon, replaceable by 1N4152
CR489	152-0141-02			Silicon, replaceable by 1N4152
CR494	152-0141-02			Silicon, replaceable by 1N4152
CR495	152-0141-02			Silicon, replaceable by 1N4152
CR496	152-0141-02			Silicon, replaceable by 1N4152
CR497	152-0141-02			Silicon, replaceable by 1N4152
CR498	152-0141-02			Silicon, replaceable by 1N4152
*CR499	152-0141-02			Silicon, replaceable by 1N4152
CR584	152-0141-02			Silicon, replaceable by 1N4152
CR585	152-0141-02			Silicon, replaceable by 1N4152
CR588	152-0141-02			Silicon, replaceable by 1N4152
CR651	152-0141-02			Silicon, replaceable by 1N4152
CR664	152-0141-02			Silicon, replaceable by 1N4152
CR720	152-0269-00			Silicon, replaceable by 1N3182
CR740	152-0141-02			Silicon, replaceable by 1N4152
CR796	152-0141-02			Silicon, replaceable by 1N4152
CR924	152-0141-02			Silicon, replaceable by 1N4152
CR944	152-0141-02			Silicon, replaceable by 1N4152
CR992	152-0141-02			Silicon, replaceable by 1N4152
CR1301	152-0141-02			Silicon, replaceable by 1N4152
CR1420	152-0141-02			Silicon, replaceable by 1N4152

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR1510	152-0141-02			Silicon, replaceable by 1N4152
CR1544	152-0141-02			Silicon, replaceable by 1N4152
CR1720	152-0141-02			Silicon, replaceable by 1N4152
CR1740	152-0269-00			Silicon, replaceable by 1N3182
CR1795	152-0141-02			Silicon, replaceable by 1N4152
CR1830	152-0141-02			Silicon, replaceable by 1N4152
CR1930	152-0141-02			Silicon, replaceable by 1N4152
CR2830	152-0141-02			Silicon, replaceable by 1N4152
CR3016	152-0141-02			Silicon, replaceable by 1N4152
CR3022	152-0141-02			Silicon, replaceable by 1N4152
CR3024	152-0141-02			Silicon, replaceable by 1N4152
CR3026	152-0141-02			Silicon, replaceable by 1N4152
CR3036	152-0141-02			Silicon, replaceable by 1N4152
CR3056	152-0141-02			Silicon, replaceable by 1N4152
CR3096	152-0141-02			Silicon, replaceable by 1N4152
CR3098	152-0141-02			Silicon, replaceable by 1N4152
CR3134	152-0141-02			Silicon, replaceable by 1N4152
CR3136	152-0141-02			Silicon, replaceable by 1N4152
CR3140	152-0141-02			Silicon, replaceable by 1N4152
CR3144	152-0141-02			Silicon, replaceable by 1N4152
CR3192	152-0141-02			Silicon, replaceable by 1N4152
CR3194	152-0141-02			Silicon, replaceable by 1N4152
CR3275	152-0141-02			Silicon, replaceable by 1N4152
CR3277	152-0141-02			Silicon, replaceable by 1N4152
CR3279	152-0141-02			Silicon, replaceable by 1N4152
CR3294	152-0141-02			Silicon, replaceable by 1N4152
CR3358	152-0141-02			Silicon, replaceable by 1N4152
CR3373	152-0141-02			Silicon, replaceable by 1N4152
CR3375	152-0141-02			Silicon, replaceable by 1N4152
CR3377	152-0141-02			Silicon, replaceable by 1N4152
CR3386	152-0141-02			Silicon, replaceable by 1N4152
CR3392	152-0141-02			Silicon, replaceable by 1N4152
CR3394	152-0141-02			Silicon, replaceable by 1N4152
CR3411	152-0141-02			Silicon, replaceable by 1N4152
CR3413	152-0141-02			Silicon, replaceable by 1N4152
CR3451	152-0141-02			Silicon, replaceable by 1N4152
CR3533	152-0141-02			Silicon, replaceable by 1N4152
CR3551	152-0141-02			Silicon, replaceable by 1N4152
CR3553	152-0141-02			Silicon, replaceable by 1N4152
CR3641	152-0141-02			Silicon, replaceable by 1N4152
CR3651	152-0141-02			Silicon, replaceable by 1N4152
CR3653	152-0141-02			Silicon, replaceable by 1N4152
CR3721	152-0141-02			Silicon, replaceable by 1N4152
CR3723	152-0141-02			Silicon, replaceable by 1N4152
CR3725	152-0141-02			Silicon, replaceable by 1N4152
CR3711	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3811	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3821	152-0141-02			Silicon, replaceable by 1N4152
CR3823	152-0141-02			Silicon, replaceable by 1N4152

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR3881	152-0141-02			Silicon, replaceable by 1N4152
CR3911	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3913	152-0141-02			Silicon, replaceable by 1N4152
CR3921	152-0141-02			Silicon, replaceable by 1N4152
CR3923	152-0141-02			Silicon, replaceable by 1N4152
CR4570	152-0141-02			Silicon, replaceable by 1N4152
CR4784	152-0141-02			Silicon, replaceable by 1N4152
CR5010	152-0141-02			Silicon, replaceable by 1N4152
CR5015	152-0141-02			Silicon, replaceable by 1N4152
CR5030	152-0141-02			Silicon, replaceable by 1N4152
CR5035	152-0141-02			Silicon, replaceable by 1N4152
CR5255	152-0141-02			Silicon, replaceable by 1N4152
CR5260	152-0141-02			Silicon, replaceable by 1N4152
CR5265	152-0141-02			Silicon, replaceable by 1N4152
CR5270	152-0141-02			Silicon, replaceable by 1N4152
CR5331	152-0322-00			Silicon, replaceable by A1108
CR5335	152-0141-02			Silicon, replaceable by 1N4152
CR5340	152-0141-02			Silicon, replaceable by 1N4152
CR5365	152-0141-02			Silicon, replaceable by 1N4152
CR5370	152-0141-02			Silicon, replaceable by 1N4152
CR5380	152-0141-02			Silicon, replaceable by 1N4152
CR5411	152-0322-00			Silicon, replaceable by A1108
CR5415	152-0141-02			Silicon, replaceable by 1N4152
CR5420	152-0141-02			Silicon, replaceable by 1N4152
CR5570	152-0141-02			Silicon, replaceable by 1N4152
CR5571	152-0141-02			Silicon, replaceable by 1N4152
CR5572	152-0141-02			Silicon, replaceable by 1N4152
CR5674	152-0141-02			Silicon, replaceable by 1N4152
CR5676	152-0141-02			Silicon, replaceable by 1N4152
CR5835	152-0269-00			Silicon, replaceable by 1N3182
CR5855	152-0141-02			Silicon, replaceable by 1N4152
CR5865	152-0141-02			Silicon, replaceable by 1N4152
CR5877	152-0141-02			Silicon, replaceable by 1N4152
CR5878	152-0141-02			Silicon, replaceable by 1N4152
CR5885	152-0141-02			Silicon, replaceable by 1N4152
CR5887	152-0141-02			Silicon, replaceable by 1N4152
CR5940	152-0141-02			Silicon, replaceable by 1N4152
CR6013	152-0141-02			Silicon, replaceable by 1N4152
CR6017	152-0141-02			Silicon, replaceable by 1N4152
CR6019	152-0141-02			Silicon, replaceable by 1N4152
CR6022	152-0141-02			Silicon, replaceable by 1N4152
CR6028	152-0141-02			Silicon, replaceable by 1N4152
CR6033	152-0141-02			Silicon, replaceable by 1N4152
CR6037	152-0141-02			Silicon, replaceable by 1N4152
CR6048	152-0141-02			Silicon, replaceable by 1N4152
CR6112	152-0141-02			Silicon, replaceable by 1N4152
CR6114	152-0141-02			Silicon, replaceable by 1N4152
CR6118	152-0141-02			Silicon, replaceable by 1N4152
CR6122	152-0141-02			Silicon, replaceable by 1N4152
CR6128	152-0141-02			Silicon, replaceable by 1N4152
CR6132	152-0141-02			Silicon, replaceable by 1N4152

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR6136	152-0141-02			Silicon, replaceable by 1N4152
CR6182	152-0125-00			Tunnel, TD3A, 4.7 mA
CR6306	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6308	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6316	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6318	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6322[1]	152-0442-00			Schottky barrier, matched pair
CR6328[2]	152-0442-00			Schottky barrier, matched pair
CR6331	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6335	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6338	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6344[3]	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6348	152-0442-00			Schottky barrier, matched pair
CR6376[4]	152-0322-00			Silicon, replaceable by A1108
CR6404	152-0442-00			Schottky barrier, matched pair
CR6464	152-0141-02			Silicon, replaceable by 1N4152
CR6466	152-0141-02			Silicon, replaceable by 1N4152
CR6469	152-0457-00			Silicon, replaceable by MD0288
CR6588	152-0141-02			Silicon, replaceable by 1N4152
CR6624	152-0141-02			Silicon, replaceable by 1N4152
CR6634	152-0141-02			Silicon, replaceable by 1N4152
CR6703	152-0141-02			Silicon, replaceable by 1N4152
CR6709	152-0141-02			Silicon, replaceable by 1N4152
CR6789	152-0141-02			Silicon, replaceable by 1N4152
CR6885	152-0141-02			Silicon, replaceable by 1N4152
CR6913	152-0141-02			Silicon, replaceable by 1N4152
CR6915	152-0141-02			Silicon, replaceable by 1N4152
CR6918	152-0141-02			Silicon, replaceable by 1N4152
CR6920	152-0141-02			Silicon, replaceable by 1N4152
CR6923	152-0141-02			Silicon, replaceable by 1N4152
CR6925	152-0141-02			Silicon, replaceable by 1N4152
CR6966	152-0141-02			Silicon, replaceable by 1N4152
CR6987	152-0141-02			Silicon, replaceable by 1N4152
CR6988	152-0141-02			Silicon, replaceable by 1N4152
CR7008	152-0141-02			Silicon, replaceable by 1N4152
CR7041	152-0141-02			Silicon, replaceable by 1N4152
CR7091	152-0141-02			Silicon, replaceable by 1N4152
CR7093	152-0141-02			Silicon, replaceable by 1N4152
CR7095	152-0141-02			Silicon, replaceable by 1N4152
CR7190	152-0141-02			Silicon, replaceable by 1N4152
CR7215	152-0141-02			Silicon, replaceable by 1N4152
CR7218	152-0141-02			Silicon, replaceable by 1N4152

[1]Furnished as a unit with CR6348.
[2]Furnished as a unit with CR6404.
[3]Furnished as a unit with CR6322.
[4]Furnished as a unit with CR6328.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
DIODES (cont)				
CR7341	152-0141-02			Silicon, replaceable by 1N4152
CR7343	152-0141-02			Silicon, replaceable by 1N4152
CR7345	152-0141-02			Silicon, replaceable by 1N4152
CR7347	152-0141-02			Silicon, replaceable by 1N4152
CR7711	152-0141-02			Silicon, replaceable by 1N4152
CR7951	152-0141-02			Silicon, replaceable by 1N4152
CR8005	152-0141-02			Silicon, replaceable by 1N4152
CR8603	152-0141-02			Silicon, replaceable by 1N4152
CR8679	152-0141-02			Silicon, replaceable by 1N4152
CR8681	152-0141-02			Silicon, replaceable by 1N4152
CR8789	152-0269-00			Silicon, replaceable by 1N3182
CR8801	152-0141-02			Silicon, replaceable by 1N4152
CR8803	152-0141-02			Silicon, replaceable by 1N4152
CR8839	152-0141-02			Silicon, replaceable by 1N4152
CR8843	152-0141-02			Silicon, replaceable by 1N4152
CR8931	152-0269-00			Silicon, replaceable by 1N3182
CR8957	152-0269-00			Silicon, replaceable by 1N3182
CR9802	152-0198-00			Silicon, replaceable by 1N4721
CR9804	152-0198-00			Silicon, replaceable by 1N4721
CR9830	152-0066-00			Silicon, selected from 1N3194
CR9832	152-0066-00			Silicon, selected from 1N3194
CR9834	152-0066-00			Silicon, selected from 1N3194
CR9836	152-0066-00			Silicon, selected from 1N3194
CR9870	152-0066-00			Silicon, selected from 1N3194
CR9872	152-0066-00			Silicon, selected from 1N3194
CR9874	152-0066-00			Silicon, selected from 1N3194
CR9876	152-0066-00			Silicon, selected from 1N3194
VR6484	152-0226-00			Zener, selected from 1N751A, 0.4 W, 1.5 V, 5%
VR7161	152-0278-00			Zener, replaceable by 1N4372A, 0.4 W, 3 V, 5%
VR8054	152-0217-00			Zener, selected from 1N756A, 0.4 W, 8.2 V, 5%
VR8355	152-0123-00			Zener, selected from 1N935A, 0.5 W, 9 V, 5%
VR9850	152-0212-00			Zener, selected from 1N936, 0.5 W, 9 V, 5%
BULBS				
DS9201	150-0018-00			Incandescent, miniature, 6.3 V
DS9202	150-0048-00			Incandescent, #683
DS9210	150-0048-00			Incandescent, #683
DS9211	150-0048-00			Incandescent, #683
DS9220	150-0048-00			Incandescent, #683
DS9221	150-0048-00			Incandescent, #683
DS9222	150-0048-00			Incandescent, #683
FILTER				
FL9201	119-0095-06			Filter, RI, 2 x 1A, 250 VAC, 400 H_z
FUSES				
F9201	159-0042-00			Cartridge, 0.75A, 3AG, fast-blo
F9202	159-0025-00			Cartridge, 0.5A, 3AG, fast-blo

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CONNECTORS				
J9001	131-0126-00			Receptacle, electrical, BNC, female
J9002	131-0126-00			Receptacle, electrical, BNC, female
J9003	131-0126-00			Receptacle, electrical, BNC, female
J9004	131-0126-00			Receptacle, electrical, BNC, female
J9005	131-0126-00			Receptacle, electrical, BNC, female
J9006	131-0126-00			Receptacle, electrical, BNC, female
J9007	131-0126-00			Receptacle, electrical, BNC, female
J9008	131-0126-00			Receptacle, electrical, BNC, female
J9009	131-0126-00			Receptacle, electrical, BNC, female
J9010	131-0126-00			Receptacle, electrical, BNC, female
J9011	131-0126-00			Receptacle, electrical, BNC, female
J9014	131-0324-00			24 pin, chassis mounted, female
J9210	131-0106-02			Receptacle, electrical, BNC
J9250	131-0106-02			Receptacle, electrical, BNC
RELAYS				
K390	148-0064-00			Relay, resonant reed, SPST
K9080	148-0034-00			Relay, armature, DPDT
INDUCTORS				
L20	114-0222-00			2-6 µH, Var, Core 276-0568-00
L30	114-0222-00			2-6 µH, Var, Core 276-0568-00
L94	114-0280-00			12-43 µH, Var, Core 276-0568-00
L438	108-0443-00			25 µH
L440	108-0443-00			25 µH
L520	276-0507-00			Core, ferramic suppressor
L720	108-0226-00			100 µH
L912	108-0443-00			25 µH
L1670	114-0308-00			2.9-6.5 µH, Var, Core 276-0506-00
L1770	108-0443-00			25 µH
L1850	108-0174-00			245 µH
L3070	108-0395-00			64 µH
L5055	108-0317-00			15 µH
L5101	114-0303-00			6.5-23 µH, Var, Core 276-0568-00
L5242	108-0174-00			245 µH
L5320	108-0174-00			245 µH
L5601	108-0317-00			15 µH
L5830	108-0231-00			4.5 µH
L6482	276-0507-00			Core, ferramic suppressor
L6852[1]	276-0507-00	XB020000		Core, ferramic suppressor
L7110	120-0785-00			Toroid, 12 turns, bifilar
L7301	114-0280-00			12-43 uH, Var, Core 276-0568-00
L7311	114-0222-00			2-6 uH, Var, Core 276-0568-00
L7401	114-0278-00			4.6-16.7 uH, Var, Core 276-0568-00
L7411	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7501	114-0278-00			4.6-16.7 µH, Var, Core 276-0568-00
L7511	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7601	114-0280-00			12-43 µH, Var, Core 276-0568-00
L7611	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7631	108-0443-00			25 µH
L8177	114-0281-00			35-70 µH, Var, Core 276-0540-00

[1]Added if necessary.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INDUCTORS (cont)				
L8287	114-0281-00			35-70 µH, Var, Core 276-0540-00
L8401	114-0219-00			45-130 µH, Var, Core 276-0568-00
L8431	114-0219-00			45-130 µH, Var, Core 276-0568-00
L8437	114-0177-00			280-650 µH, Var, Core not replaceable
L8461	114-0278-00			4.6-16.7 µH, Var, Core 276-0568-00
L8501	114-0219-00			45-130 µH, Var, Core 276-0568-00
L8531	114-0219-00			45-130 µH, Var, Core 276-0568-00
L8591	114-0254-00			30-60 µH, Var, Core 276-0506-00
L8629	114-0177-00			280-650 µH, Var, Core not replaceable
L8953	114-0310-00			22-80 µH, Var, Core 276-0568-00
TRANSISTORS				
Q10	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q30	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q40	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q50	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q55	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q60	151-0225-00			Silicon, NPN, selected from 2N3563 or replaceable by CS23366
Q70	151-0225-00			Silicon, NPN, selected from 2N3563 or replaceable by CS23366
Q80	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q90	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q160	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q230	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q240	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q250	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q260	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q319	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q350	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q355	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q360	151-0192-00			Silicon, NPN, selected from MPS6521
Q380	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q400	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q402	151-0223-00			Silicon, NPN, replacelabe by 2N4275
Q404	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q450	151-0192-00			Silicon, NPN, selected from MPS6521
Q458	151-0192-00			Silicon, NPN, selected from MPS6521
Q460	151-0192-00			Silicon, NPN, selected from MPS6521
Q469	151-0192-00			Silicon, NPN, selected from MPS6521
Q470	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q478	151-0192-00			Silicon, NPN, selected from MPS6521
Q479	151-0192-00			Silicon, NPN, selected from MPS6521
Q480	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q488	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q489	151-0192-00			Silicon, NPN, selected from MPS6521
Q498	151-0192-00			Silicon, NPN, selected from MPS6521
Q499	151-0192-00			Silicon, NPN, selected from MPS6521
Q510	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q520	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q540	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q550	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q560	151-0301-00			Silicon, PNP, replaceable by 2N3907
Q565	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q570	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q580	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q620	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q630	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q640	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q658	151-0301-00			Silicon, PNP, replaceable by 2N3907
Q680	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q730A,B	151-0104-00			Silicon, NPN, selected from 2N2919, dual
Q740	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q750	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q760	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q790	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q820	151-1039-00			Silicon, FET, replaceable by 2N5462
Q840	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q860	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q880	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q885	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q900	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q905	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q920	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q930	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q950	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q960	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q965	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q980	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q990	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1401	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1411	151-0190-01			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1421	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1501	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1601	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1631	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1691	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1701	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1721	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q1731	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1741	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1791	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1801	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1811	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1901	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1911	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1921	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q1991	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3020	151-0192-00			Silicon, NPN, selected from MPS6521
Q3030	151-0192-00			Silicon, NPN, selected from MPS6521
Q3040	151-0192-00			Silicon, NPN, selected from MPS6521
Q3050	151-0192-00			Silicon, NPN, selected from MPS6521
Q3060	151-0192-00			Silicon, NPN, selected from MPS6521
Q3070	151-0192-00			Silicon, NPN, selected from MPS6521
Q3296	151-0192-00			Silicon, NPN, selected from MPS6521
Q3298	151-0192-00			Silicon, NPN, selected from MPS6521
Q3367	151-0225-00			Silicon, NPN, selected from 2N3563 or replaceable by CS23366
Q3376	151-0192-00			Silicon, NPN, selected from MPS6521
Q3398	151-0192-00			Silicon, NPN, selected from MPS6521
Q3420	151-0192-00			Silicon, NPN, selected from MPS6521
Q3430	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q3440	151-1039-00			Silicon, FET, replaceable by 2N5462
Q3450	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3470	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3492	151-0192-00			Silicon, NPN, selected from MPS6521
Q3496	151-0192-00			Silicon, NPN, selected from MPS6521
Q3510	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3520	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3530	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q3540	151-0269-00			Silicon, NPN, replaceable by SE3005
Q3545	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3580	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3600	151-0192-00			Silicon, NPN, selected from MPS6521
Q3610	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3645	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3720	151-0192-00			Silicon, NPN, selected from MPS6521
Q3780	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3820	151-0192-00			Silicon, NPN, selected from MPS6521
Q3825	151-0192-00			Silicon, NPN, selected from MPS6521
Q3880	151-0192-00			Silicon, NPN, selected from MPS6521
Q3890	151-0192-00			Silicon, NPN, selected from MPS6521
Q3920	151-0192-00			Silicon, NPN, selected from MPS6521
Q4180	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4190	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4280	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4290	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4380	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4390	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4480	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4490	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5021	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5031	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5041	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5051	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5091	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5131	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q5141	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q5151	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5161	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5171	151-0192-00			Silicon, NPN, selected from MPS6521
Q5181	151-0192-00			Silicon, NPN, selected from MPS6521
Q5191	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q5231	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5241	151-0198-00			Silicon, NPN, replaceable by MPS918
Q5251	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5261	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5271	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5281	151-0192-00			Silicon, NPN, selected from MPS6521
Q5291	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5311	151-0198-00			Silicon, NPN, replaceable by MPS918
Q5331	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5341	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5351	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5361	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5371	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5381	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5391	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5431	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5441	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5451	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5461	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5471	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5481	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5491	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5511	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5521	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5551	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5561	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5571	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5581	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q5591	151-0127-00			Silicon, NPN, selected from 2N2369
Q5661	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5681	151-0127-00			Silicon, NPN, selected from 2N2369
Q5721	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5731	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5741	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5751	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5761	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5771	151-0192-00			Silicon, NPN, selected from MPS6521
Q5781	151-0192-00			Silicon, NPN, selected from MPS6521
Q5791	151-0192-00			Silicon, NPN, selected from MPS6521
Q5821	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5831	151-0219-00			Silicon, PNP, replaceable by 2N4250

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q5841	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5851	151-0192-00			Silicon, NPN, selected from MPS6521
Q5861	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5871	151-0192-00			Silicon, NPN, selected from MPS6521
Q5881	151-0192-00			Silicon, NPN, selected from MPS6521
Q5891	151-0192-00			Silicon, NPN, selected from MPS6521
Q5931	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q5941	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5951	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q5961	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5971	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5981	151-0192-00			Silicon, NPN, selected from MPS6521
Q5991	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6010	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6068	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6091	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6095	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6103	151-0127-00			Silicon, NPN, selected from 2N2369
Q6106	151-0192-00			Silicon, NPN, selected from MPS6521
Q6149	151-0192-00			Silicon, NPN, selected from MPS6521
Q6162	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6164	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6192	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6198	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q6212	151-0192-00			Silicon, NPN, selected from MPS6521
Q6222	151-0192-00			Silicon, NPN, selected from MPS6521
Q6228	151-0192-00			Silicon, NPN, selected from MPS6521
Q6233	151-0192-00			Silicon, NPN, selected from MPS6521
Q6244	151-0192-00			Silicon, NPN, selected from MPS6521
Q6255	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6262	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q6266	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6298	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6392	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6398	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q6452	151-0192-00			Silicon, NPN, selected from MPS6521
Q6478	151-0133-00			Silicon, PNP, replaceable by MM999 or selected from 2N3251
Q6482	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q6494	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6496	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6569	151-0192-00			Silicon, NPN, selected from MPS6521
Q6593	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6624A,B	151-0361-00			Silicon, replaceable by TD702, dual
Q6653A,B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074, dual
Q6672	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q6758	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q6772	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q6786	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6803	151-0192-00			Silicon, NPN, selected from MPS6521

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q6813	151-0192-00			Silicon, NPN, selected from MPS6521
Q6824	151-0192-00			Silicon, NPN, selected from MPS6521
Q6828	151-0192-00			Silicon, NPN, selected from MPS6521
Q6852	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6858	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6877	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q7001	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7191	151-0325-00			Silicon, PNP, replaceable by 2N4258
Q7221	151-0192-00			Silicon, NPN, selected from MPS6521
Q7241	151-0192-00			Silicon, NPN, selected from MPS6521
Q7251	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7321	151-0192-00			Silicon, NPN, replaceable by MPS6521
Q7331	151-0192-00			Silicon, NPN, replaceable by MPS6521
Q7431	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q7443	151-0192-00			Silicon, NPN, selected from MPS6521
Q7481	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7531	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7571	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7630	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7711	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7763A,B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074, dual
Q7771	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7781	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q7783	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q7811	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7911	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7921	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q7961	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q7971	151-0192-00			Silicon, NPN, selected from MPS6521
Q7981	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q8003	151-0192-00			Silicon, NPN, selected from MPS6521
Q8035	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q8133A,B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074, dual
Q8227A,B	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q8230A,B	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q8333A,B	151-0232-00			Silicon, NPN, replaceable by NS7348 or selected from 2N2919, dual
Q8455	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8479	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q8483	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q8485	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q8551	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8577	151-0207-00			Silicon, NPN, replaceable by 2N3415

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q8605	151-0192-00			Silicon, NPN, selected from MPS6521
Q8701	151-0192-00			Silicon, NPN, selected from MPS6521
Q8703	151-0192-00			Silicon, NPN, selected from MPS6521
Q8739	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8755	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8781	151-0192-00			Silicon, NPN, selected from MPS6521
Q8837	151-0192-00			Silicon, NPN, selected from MPS6521
Q8851	151-0269-00			Silicon, NPN, replaceable by SE3005
Q8857	151-0269-00			Silicon, NPN, replaceable by SE3005
Q8889	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8903	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q8927	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q8937	151-0192-00			Silicon, NPN, selected from MPS6521
Q9035	151-0140-00			Silicon, NPN, selected from 2N3055
Q9055	151-0140-00			Silicon, NPN, selected from 2N3055
Q9085	151-0148-00	B010100	B029999	Silicon, NPN, selected from 40250
Q9085	151-0140-00	B030000		Silicon, NPN, selected from 2N3055
Q9800	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9802	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9804	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9806	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9830	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9832	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9834	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9836	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9850	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9852	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9854	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9856	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
RESISTORS				
R3	321-0193-00			1 kΩ, 1/8 W, 1%
R5	321-0251-00			4.02 kΩ, 1/8 W, 1%
R7	321-0239-00			3.01 kΩ, 1/8 W, 1%
R12	315-0220-00			22 Ω, 1/4 W, 5%
R30	321-0277-00			7.5 kΩ, 1/8 W, 1%
R32	321-0222-00			2 kΩ, 1/8 W, 1%
R36	321-0105-00			121 Ω, 1/8 W, 1%
R40	315-0202-00			2 kΩ, 1/4 W, 5%
R45	321-0275-00			7.15 kΩ, 1/8 W, 1%
R50	322-0085-00			75 Ω, 1/4 W, 1%
R52	315-0102-00			1 kΩ, 1/4 W, 5%
R54	315-0563-00			56 kΩ,1/4 W, 5%
R56	315-0103-00			10 kΩ, 1/4 W, 5%
R57	315-0103-00			10 kΩ, 1/4 W, 5%
R59	315-0100-00			10 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R60	321-0312-00			17.4 kΩ, 1/8 W, 1%
R62	315-0102-00			1 kΩ, 1/4 W, 5%
R64	315-0470-00			47 Ω, 1/4 W, 5%
R66	315-0182-00			1.8 kΩ, 1/4 W, 5%
R70	321-0277-00			7.5 kΩ, 1/8 W, 1%
R74	321-0235-00			2.74 kΩ, 1/8 W, 1%
R84	315-0102-00			1 kΩ, 1/4 W, 5%
R86	315-0470-00			47 Ω, 1/4 W, 5%
R134	321-0210-00			1.5 kΩ, 1/8 W, 1%
R138	315-0122-00			1.2 kΩ, 1/4 W, 5%
R140	315-0471-00			470 Ω, 1/4 W, 5%
R150	311-1224-00			500 Ω, Var
R151	315-0471-00			470 Ω, 1/4 W, 5%
R152	315-0153-00			15 kΩ, 1/4 W, 5%
R155	321-0293-00			11 kΩ, 1/8 W, 1%
R158	308-0252-00			390 Ω, 3 W, WW, 5%
R160	321-0235-00			2.74 kΩ, 1/8 W, 1%
R162	321-0251-00			4.02 kΩ, 1/8 W, 1%
R190	315-0472-00			4.7 kΩ, 1/4 W, 5%
R235	321-0247-00			3.65 kΩ, 1/8 W, 1%
R240	315-0471-00			470 Ω, 1/4 W, 5%
R245	315-0122-00			1.2 kΩ, 1/4 W, 5%
R250	311-1225-00			1 kΩ, Var
R255	315-0472-00			4.7 kΩ, 1/4 W, 5%
R260	315-0270-00			27 Ω, 1/4 W, 5%
R280	322-0085-00			75 Ω, 1/4 W, 1%
R285	315-0101-00			100 Ω, 1/4 W, 5%
R289	315-0102-00			1 kΩ, 1/4 W, 5%
R301	315-0102-00			1 kΩ, 1/4 W, 5%
R329	315-0472-00			4.7 kΩ, 1/4 W, 5%
R335	321-0314-00			18.2 kΩ, 1/8 W, 1%
R336	315-0472-00			4.7 kΩ, 1/4 W, 5%
R337	315-0472-00			4.7 kΩ, 1/4 W, 5%
R339	315-0272-00			2.7 kΩ, 1/4 W, 5%
R350	311-1227-00			5 kΩ, Var
R352	315-0472-00			4.7 kΩ, 1/4 W, 5%
R354	315-0472-00			4.7 kΩ, 1/4 W, 5%
R356	315-0102-00			1 kΩ, 1/4 W, 5%
R361	315-0470-00			47 Ω, 1/4 W, 5%
R362	315-0182-00			1.8 kΩ, 1/4 W, 5%
R380	315-0301-00			300 Ω, 1/4 W, 5%
R385	315-0392-00			3.9 kΩ, 1/4 W, 5%
R388	315-0101-00			100 Ω, 1/4 W, 5%
R401	315-0272-00			2.7 kΩ, 1/4 W, 5%
R402	315-0272-00			2.7 kΩ, 1/4 W, 5%
R403	315-0272-00			2.7 kΩ, 1/4 W, 5%
R404	315-0302-00			3 kΩ, 1/4 W, 5%
R405	315-0103-00			10 kΩ, 1/4 W, 5%
R406	321-0293-00			11 kΩ, 1/8 W, 1%
R407	315-0202-00			2 kΩ, 14/ W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R408	315-0302-00			3 kΩ, 1/4 W, 5%
R409	315-0202-00			2 kΩ, 1/4 W, 5%
R410	315-0102-00			1 kΩ, 1/4 W, 5%
R411	321-0306-00			15 kΩ, 1/8 W, 1%
R438	315-0103-00			10 kΩ, 1/4 W, 5%
R448	315-0100-00			10 Ω, 1/4 W, 5%
R449	315-0272-00			2.7 kΩ, 1/4 W, 5%
R450	311-1223-00			250 Ω, Var
R451	315-0471-00			470 Ω, 1/4 W, 5%
R452	315-0103-00			10 kΩ, 1/4 W, 5%
R455	311-1227-00			5 kΩ, Var
R456	321-0293-00			11 kΩ, 1/8 W, 1%
R458	315-0272-00			2.7 kΩ, 1/4 W, 5%
R460	315-0103-00			10 kΩ, 1/4 W, 5%
R461	315-0471-00			470 Ω, 1/4 W, 5%
R466	321-0323-00			22.6 kΩ, 1/8 W, 1%
R467	311-1230-00			20 kΩ, Var
R468	315-0101-00			100 Ω, 1/4 W, 5%
R471	315-0752-00			7.5 kΩ, 1/4 W, 5%
R474	321-0289-00			10 kΩ, 1/8 W, 1%
R475	311-1228-00			10 kΩ, Var
R476	311-1227-00			5 kΩ, Var
R477	321-0366-00			63.4 kΩ, 1/8 W, 1%
R478	315-0102-00			1 kΩ, 1/4 W, 5%
R481	315-0622-00			6.2 kΩ, 1/4 W, 5%
R482	315-0101-00			100 Ω, 1/4 W, 5%
R484	311-1226-00			2.5 kΩ, Var
R485	321-0327-00			24.9 kΩ, 1/8 W, 1%
R488	315-0101-00			100 Ω, 1/4 W, 5%
R490	315-0102-00			1 kΩ, 1/4 W, 5%
R491	315-0472-00			4.7 kΩ, 1/4 W, 5%
R492	311-1227-00			5 kΩ, Var
R493	311-1268-00			10 kΩ, Var
R494	321-0356-00			49.9 kΩ, 1/8 W, 1%
R495	321-0356-00			49.9 kΩ, 1/8 W, 1%
R501	315-0431-00			430 Ω, 1/4 W, 5%
R504	321-0176-00			665 Ω, 1/8 W, 1%
R505	311-1261-00			500 Ω, Var
R512	321-0157-00			422 Ω, 1/8 W, 1%
R520	315-0101-00			100 Ω, 1/4 W, 5%
R525	315-0333-00			33 kΩ, 1/4 W, 5%
R526	321-0222-00			2 kΩ, 1/8 W, 1%
R528	315-0221-00			220 Ω, 1/4 W, 5%
R530	321-0222-00			2 kΩ, 1/8 W, 1%
R550	321-0152-00			374 Ω, 1/8 W, 1%
R552	315-0101-00			100 Ω, 1/4 W, 5%
R553	321-0296-00			11.8 kΩ, 1/8 W, 1%
R555	321-0085-01			75 Ω, 1/8 W, 1/2%
R562	315-0682-00			6.8 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R566	321-0241-00			3.16 kΩ, 1/8 W, 1%
R576	315-0392-00			3.9 kΩ, 1/4 W, 5%
R583	315-0472-00			4.7 kΩ, 1/4 W, 5%
R586	315-0911-00			910 Ω, 1/4 W, 5%
R587	315-0152-00			1.5 kΩ, 1/4 W, 5%
R588	315-0101-00			100 Ω, 1/4 W, 5%
R592	315-0470-00			47 Ω, 1/4 W, 5%
R594	315-0362-00			3.6 kΩ, 1/4 W, 5%
R596	315-0561-00			560 Ω, 1/4 W, 5%
R597	315-0911-00			910 Ω, 1/4 W, 5%
R598	315-0104-00			100 kΩ, 1/4 W, 5%
R612	315-0682-00			6.8 kΩ, 1/4 W, 5%
R618	315-0106-00			100 MΩ, 1/4 W, 5%
R619	301-0681-00			680 Ω, 1/2 W, 5%
R625	321-0193-00			1 kΩ, 1/8 W, 1%
R627	315-0101-00			100 Ω, 1/4 W, 5%
R630	315-0201-00			200 Ω, 1/4 W, 5%
R642	321-0612-03			500 Ω, 1/8 W, 1/4%
R654	321-0171-00			590 Ω, 1/8 W, 1%
R658	315-0101-00			100 Ω, 1/4 W, 5%
R659	315-0182-00			1.8 kΩ, 1/4 W, 5%
R662	315-0153-00			15 kΩ, 1/4 W, 5%
R666	315-0561-00			560 Ω, 1/4 W, 5%
R668	315-0153-00			15 kΩ, 1/4 W, 5%
R670	321-0171-00			590 Ω, 1/8 W, 1%
R674	315-0101-00			100 Ω, 1/4 W, 5%
R676	321-0612-03			500 Ω, 1/8 W, 1/4%
R677	315-0102-00			1 kΩ, 1/4 W, 5%
R684	315-0470-00			47 Ω, 1/4 W, 5%
R690	315-0911-00			910 Ω, 1/4 W, 5%
R692	321-0085-00			75 Ω, 1/8 W, 1%
R693	315-0392-00			3.9 kΩ, 1/4 W, 5%
R694	315-0680-00			68 Ω, 1/4 W, 5%
R698	321-0085-00			75 Ω, 1/8 W, 1%
R707	315-0563-00			56 kΩ, 1/4 W, 5%
R710	315-0470-00			47 Ω, 1/4 W, 5%
R711	315-0823-00			82 kΩ, 1/4 W, 5%
R714	315-0470-00			47 Ω, 1/4 W, 5%
R716	315-0823-00			82 kΩ, 1/4 W, 5%
R718	315-0183-00			18 kΩ, 1/4 W, 5%
R720	315-0470-00			47 Ω, 1/4 W, 5%
R735	311-1272-00			100 kΩ, Var
R740	315-0102-00			1 kΩ, 1/4 W, 5%
R748	321-0612-03			500 Ω, 1/8 W, 1/4%
R749	315-0182-00			1.8 kΩ, 1/4 W, 5%
R750	321-0131-00			226 Ω, 1/8 W, 1%
R754	315-0182-00			1.8 kΩ, 1/4 W, 5%
R756	321-0178-00			698 Ω, 1/8 W, 1%
R757	321-0126-00			200 Ω, 1/8 W, 1%
R759	321-0126-00			200 Ω, 1/8 W, 1%
R765	311-1260-00			250 Ω, Var

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS	(cont)			
R766	315-0431-00			430 Ω, 1/4 W, 5%
R770	315-0101-00			100 Ω, 1/4 W, 5%
R772	321-0612-03			500 Ω, 1/8 W, 1/4%
R773	315-0123-00			12 kΩ, 1/4 W, 5%
R774	321-0131-00			226 Ω, 1/8 W, 1%
R775	311-1271-00			50 kΩ, Var
R780	311-1261-00			500 Ω, Var
R785	311-1271-00			50 kΩ, Var
R786	315-0333-00			33 kΩ, 1/4 W, 5%
R790	301-0821-00			820 Ω, 1/2 W, 5%
R797	307-0103-00			2.7 Ω, 1/4 W, 5%
R806	315-0102-00			1 kΩ, 1/4 W, 5%
R808	315-0472-00			4.7 kΩ, 1/4 W, 5%
R817	321-0372-00			73.2 kΩ, 1/8 W, 1%
R819	321-0374-00			76.8 kΩ, 1/8 W, 1%
R820	315-0474-00			470 kΩ, 1/4 W, 5%
R821	315-0101-00			100 Ω, 1/4 W, 5%
R840	321-0238-00			2.94 kΩ, 1/8 W, 1%
R842	321-0165-00			511 Ω, 1/8 W, 1%
R843	321-0258-00			4.75 kΩ, 1/8 W, 1%
R845	315-0470-00			47 Ω, 1/4 W, 5%
R847	321-0612-03			500 Ω, 1/8 W, 1/4%
R848	315-0470-00			47 Ω, 1/4 W, 5%
R849	315-0102-00			1 kΩ, 1/4 W, 5%
R850	321-0171-00			590 Ω, 1/8 W, 1%
R854	315-0101-00			100 Ω, 1/4 W, 5%
R856	315-0182-00			1.8 kΩ, 1/4 W, 5%
R862	315-0221-00			220 Ω, 1/4 W, 5%
R863	321-0239-00			3.01 kΩ, 1/8 W, 1%
R868	321-0210-00			1.5 kΩ, 1/8 W, 1%
R870	321-0171-00			590 Ω, 1/8 W, 1%
R872	315-0101-00			100 Ω, 1/4 W, 5%
R874	321-0612-03			500 Ω, 1/8 W, 1/4%
R876	315-0470-00			47 Ω, 1/4 W, 5%
R883	301-0122-00			1.2 kΩ, 1/2 W, 5%
R888	315-0102-00			1 kΩ, 1/4 W, 5%
R890	315-0362-00			3.6 kΩ, 1/4 W, 5%
R893	315-0151-00			150 Ω, 1/4 W, 5%
R896	321-0085-00			75 Ω, 1/8 W, 1%
R897	321-0085-00			75 Ω, 1/8 W, 1%
R898	301-0821-00			820 Ω, 1/2 W, 5%
R906	315-0682-00			6.8 kΩ, 1/4 W, 5%
R908	315-0470-00			47 Ω, 1/4 W, 5%
R910	315-0332-00			3.3 kΩ, 1/4 W, 5%
R912	315-0202-00			2 kΩ, 1/4 W, 5%
R915	315-0332-00			3.3 kΩ, 1/4 W, 5%
R917	315-0102-00			1 kΩ, 1/4 W, 5%
R919	315-0153-00			15 kΩ, 1/4 W, 5%
R920	315-0100-00			10 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R926	315-0563-00			56 kΩ, 1/4 W, 5%
R928	315-0221-00			220 Ω, 1/4 W, 5%
R940	321-0612-03			500 Ω, 1/8 W, 1/4%
R942	315-0182-00			1.8 kΩ, 1/4 W, 5%
R943	321-0131-00			226 Ω, 1/8 W, 1%
R950	321-0178-00			698 Ω, 1/8 W, 1%
R952	315-0182-00			1.8 kΩ, 1/4 W, 5%
R954	321-0126-00			200 Ω, 1/8 W, 1%
R955	321-0126-00			200 Ω, 1/8 W, 1%
R957	321-0238-00			2.94 kΩ, 1/8 W, 1%
R958	321-0165-00			511 Ω, 1/8 W, 1%
R959	321-0258-00			4.75 kΩ, 1/8 W, 1%
R963	311-1260-00			250 Ω, Var
R966	315-0431-00			430 Ω, 1/4 W, 5%
R969	315-0221-00			220 Ω, 1/4 W, 5%
R970	315-0101-00			100 Ω, 1/4 W, 5%
R971	321-0612-03			500 Ω, 1/8 W, 1/4%
R972	315-0123-00			12 kΩ, 1/4 W, 5%
R973	321-0131-00			226 Ω, 1/8 W, 1%
R975	311-1271-00			50 kΩ, Var
R976	315-0333-00			33 kΩ, 1/4 W, 5%
R977	321-0239-00			3.01 kΩ, 1/8 W, 1%
R978	321-0210-00			1.5 kΩ, 1/8 W, 1%
R979	301-0122-00			1.2 kΩ, 1/2 W, 5%
R985	311-1271-00			50 kΩ, Var
R993	307-0103-00			2.7 Ω, 1/4 W, 5%
R994	315-0680-00			68 Ω, 1/4 W, 5%
R995	315-0362-00			3.6 kΩ, 1/4 W, 5%
R996	315-0151-00			150 Ω, 1/4 W, 5%
R997	315-0241-00			240 Ω, 1/4 W, 5%
R1000	315-0102-00			1 kΩ, 1/4 W, 5%
R1098	315-0102-00			1 kΩ, 1/4 W, 5%
R1350	315-0103-00			10 kΩ, 1/4 W, 5%
R1365	315-0102-00			1 kΩ, 1/4 W, 5%
R1395	315-0102-00			1 kΩ, 1/4 W, 5%
R1400	315-0185-00			1.8 MΩ, 1/4 W, 5%
R1401	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1420	315-0103-00			10 kΩ, 1/4 W, 5%
R1430	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1501	315-0275-00			2.7 MΩ, 1/4 W, 5%
R1502	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1520	315-0333-00			33 kΩ, 1/4 W, 5%
R1530	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1601	321-0255-00			4.42 kΩ, 1/8 W, 1%
R1602	321-0270-00			6.34 kΩ, 1/8 W, 1%
R1630	315-0392-00			3.9 kΩ, 1/4 W, 5%
R1631	315-0103-00			10 kΩ, 1/4 W, 5%
R1632	315-0392-00			3.9 kΩ, 1/4 W, 5%
R1650	315-0102-00			1 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R1655	315-0202-00			2 kΩ, 1/4 W, 5%
R1695	315-0181-00			180 Ω, 1/4 W, 5%
R1701	315-0513-00			51 kΩ, 1/4 W, 5%
R1710	315-0102-00			1 kΩ, 1/4 W, 5%
R1715	315-0222-00			2.2 kΩ, 1/4 W, 5%
R1720	315-0153-00			15 kΩ, 1/4 W, 5%
R1721	315-0124-00			120 kΩ, 1/4 W, 5%
R1725	315-0473-00			47 kΩ, 1/4 W, 5%
R1730	315-0474-00			470 kΩ, 1/4 W, 5%
R1732	315-0155-00			1.5 MΩ, 1/4 W, 5%
R1735	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1740	315-0102-00			1 kΩ, 1/4 W, 5%
R1750	315-0271-00			270 Ω, 1/4 W, 5%
R1755	315-0622-00			6.2 kΩ, 1/4 W, 5%
R1760	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1791	315-0103-00			10 kΩ, 1/4 W, 5%
R1793	315-0333-00			33 kΩ, 1/4 W, 5%
R1795	315-0391-00			390 Ω, 1/4 W, 5%
R1798	315-0821-00			820 Ω, 1/4 W, 5%
R1799	315-0223-00			22 kΩ, 1/4 W, 5%
R1805	315-0113-00			11 kΩ, 1/4 W, 5%
R1810	321-0255-00			4.42 kΩ, 1/8 W, 1%
R1820	321-0270-00			6.34 kΩ, 1/8 W, 1%
R1830	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1835	315-0122-00			1.2 kΩ, 1/4 W, 5%
R1840	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1890	315-0333-00			33 kΩ, 1/4 W, 5%
R1893	321-0312-00			17.4 kΩ, 1/8 W, 1%
R1900	315-0432-00			4.3 kΩ, 1/4 W, 5%
R1903	315-0272-00			2.7 kΩ, 1/4 W, 5%
R1930	315-0154-00			150 kΩ, 1/4 W, 5%
R1935	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1940	315-0471-00			470 Ω, 1/4 W, 5%
R1950	315-0473-00			47 kΩ, 1/4 W, 5%
R1955	315-0473-00			47 kΩ, 1/4 W, 5%
R1988	311-1268-00			10 kΩ, Var
R1990	315-0101-00			100 Ω, 1/4 W, 5%
R1991	315-0101-00			100 Ω, 1/4 W, 5%
R1998	315-0240-00			24 Ω, 1/4 W, 5%
R2662	315-0512-00			5.1 kΩ, 1/4 W, 5%
R2701	315-0102-00			1 kΩ, 1/4 W, 5%
R2706	315-0100-00			10 Ω, 1/4 W, 5%
R2710	315-0102-00			1 kΩ, 1/4 W, 5%
R2715	311-0633-00			5 kΩ, Var
R2720	321-0289-00			10 kΩ, 1/8 W, 1%
R2724	321-0318-00			20 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R2734	315-0201-00			200 Ω, 1/4 W, 5%
R2820	321-0318-00			20 kΩ, 1/8 W, 1%
R2882	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2910	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2915	315-0102-00			1 kΩ, 1/4 W, 5%
R2918	315-0471-00			470 Ω, 1/4 W, 5%
R2920	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2922	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2932	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2934	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2970	315-0102-00			1 kΩ, 1/4 W, 5%
R2978	315-0100-00			10 Ω, 1/4 W, 5%
R2980	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3015	315-0101-00			100 Ω, 1/4 W, 5%
R3042	315-0101-00			100 Ω, 1/4 W, 5%
R3044	315-0101-00			100 Ω, 1/4 W, 5%
R3061	315-0101-00			100 Ω, 1/4 W, 5%
R3074	311-1266-00			2.5 kΩ, Var
R3076	311-1266-00			2.5 kΩ, Var
R3084	311-1266-00			2.5 kΩ, Var
R3086	311-1266-00			2.5 kΩ, Var
R3110	315-0183-00			18 kΩ, 1/4 W, 5%
R3114	315-0183-00			18 kΩ, 1/4 W, 5%
R3120	315-0681-00			680 Ω, 1/4 W, 5%
R3122	315-0681-00			680 Ω, 1/4 W, 5%
R3124	315-0681-00			680 Ω, 1/4 W, 5%
R3128	315-0471-00			470 Ω, 1/4 W, 5%
R3148	315-0102-00			1 kΩ, 1/4 W, 5%
R3160	321-0327-00			24.9 kΩ, 1/8 W, 1%
R3164	321-0309-00			16.2 kΩ, 1/8 W, 1%
R3166	321-0355-00			48.7 kΩ, 1/8 W, 1%
R3168	321-0301-00			13.3 kΩ, 1/8 W, 1%
R3174	311-0633-00			5 kΩ, Var
R3176	311-1263-00			1 kΩ, Var
R3184	311-0633-00			5 kΩ, Var
R3186	311-1263-00			1 kΩ, Var
R3196	311-0633-00			5 kΩ, Var
R3198	311-1263-00			1 kΩ, Var
R3260	321-0296-00			11.8 kΩ, 1/8 W, 1%
R3264	321-0372-00			73.2 kΩ, 1/8 W, 1%
R3265	315-0681-00			680 Ω, 1/4 W, 5%
R3269	315-0681-00			680 Ω, 1/4 W, 5%
R3274	311-0607-00			10 kΩ, Var
R3284	311-1266-00			2.5 kΩ, Var
R3290	321-0289-00			10 kΩ, 1/8 W, 1%
R3293	321-0369-00			68.1 kΩ, 1/8 W, 1%
R3295	321-0326-00			24.3 kΩ, 1/8 W, 1%
R3310	315-0102-00			1 kΩ, 1/4 W, 5%
R3311	321-0323-00			22.6 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R3337	321-0352-00			45.3 kΩ, 1/8 W, 1%
R3358	315-0752-00			7.5 kΩ, 1/4 W, 5%
R3363	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3365	315-0101-00			100 Ω, 1/4 W, 5%
R3367	315-0681-00			680 Ω, 1/4 W, 5%
R3369	311-0607-00			10 kΩ, Var
R3393	321-0369-00			68.1 kΩ, 1/8 W, 1%
R3395	321-0298-00			12.4 kΩ, 1/8 W, 1%
R3410	311-1230-00			20 kΩ, Var
R3411	315-0101-00			100 Ω, 1/4 W, 5%
R3420	311-1230-00			20 kΩ, Var
R3431	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3450	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3451	315-0104-00			100 kΩ, 1/4 W, 5%
R3453	315-0331-00			330 Ω, 1/4 W, 5%
R3481	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3490	321-0322-00			22.1 kΩ, 1/8 W, 1%
R3491	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3511	321-0216-00			1.74 kΩ, 1/8 W, 1%
R3513	315-0512-00			5.1 kΩ, 1/4 W, 5%
R3515	315-0562-00			5.6 kΩ, 1/4 W, 5%
R3517	315-0392-00			3.9 kΩ, 1/4 W, 5%
R3524	315-0153-00			15 kΩ, 1/4 W, 5%
R3523	315-0100-00			10 Ω, 1/4 W, 5%
R3531	315-0563-00			56 kΩ, 1/4 W, 5%
R3541	315-0682-00			6.8 kΩ, 1/4 W, 5%
R3553	315-0103-00			10 kΩ, 1/4 W, 5%
R3555	315-0104-00			100 kΩ, 1/4 W, 5%
R3557	315-0331-00			330 Ω, 1/4 W, 5%
R3581	315-0153-00			15 kΩ, 1/4 W, 5%
R3583	315-0153-00			15 kΩ, 1/4 W, 5%
R3585	315-0182-00			1.8 kΩ, 1/4 W, 5%
R3610	315-0470-00			47 Ω, 1/4 W, 5%
R3616	311-1230-00			20 kΩ, Var
R3621	321-0353-00			46.4 kΩ, 1/8 W, 1%
R3623	315-0100-00			10 Ω, (nominal value), selected
R3625	315-0102-00			1 kΩ, 1/4 W, 5%
R3641	321-0298-00			12.4 kΩ, 1/8 W, 1%
R3661	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3663	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3671	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3711	321-0262-00			5.23 kΩ, 1/8 W, 1%
R3713	315-0102-00			1 kΩ, 1/4 W, 5%
R3791	316-0335-00			3.3 MΩ, 1/4 W, 10%
R3793	316-0335-00			3.3 MΩ, 1/4 W, 10%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R3795	315-0752-00			7.5 kΩ, 1/4 W, 5%
R3811	321-0266-00			5.76 kΩ, 1/8 W, 1%
R3813	321-0358-00			52.3 kΩ, 1/8 W, 1%
R3814	315-0100-00			10 Ω, 1/4 W, 5%
R3840	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3890	315-0513-00			51 kΩ, 1/4 W, 5%
R3911	315-0102-00			1 kΩ, 1/4 W, 5%
R3913	321-0262-00			5.23 kΩ, 1/8 W, 1%
R3961	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3993	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3995	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3997	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4174	315-0102-00			1 kΩ, 1/4 W, 5%
R4184	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4188	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4250	315-0102-00			1 kΩ, 1/4 W, 5%
R4254	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4260	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4270	315-0102-00			1 kΩ, 1/4 W, 5%
R4272	315-0102-00			1 kΩ, 1/4 W, 5%
R4280	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4290	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4370	315-0102-00			1 kΩ, 1/4 W, 5%
R4390	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4468	315-0102-00			1 kΩ, 1/4 W, 5%
R4470	315-0102-00			1 kΩ, 1/4 W, 5%
R4484	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4486	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4488	315-0332-00			3.3 kΩ, 1/4 W, 5%
R4550	315-0102-00			1 kΩ, 1/4 W, 5%
R4728	315-0102-00			1 kΩ, 1/4 W, 5%
R4768	315-0102-00			1 kΩ, 1/4 W, 5%
R4772	315-0102-00			1 kΩ, 1/4 W, 5%
R4776	315-0102-00			1 kΩ, 1/4 W, 5%
R4780	315-0102-00			1 kΩ, 1/4 W, 5%
R4786	315-0102-00			1 kΩ, 1/4 W, 5%
R4920	315-0102-00			1 kΩ, 1/4 W, 5%
R4922	315-0102-00			1 kΩ, 1/4 W, 5%
R4960	315-0102-00			1 kΩ, 1/4 W, 5%
R4996	315-0102-00			1 kΩ, 1/4 W, 5%
R5018	315-0153-00			15 kΩ, 1/4 W, 5%
R5020	315-0272-00			2.7 kΩ, 1/4 W, 5%
R5022	315-0392-00			3.9 kΩ, 1/4 W, 5%
R5030	315-0822-00			8.2 kΩ, 1/4 W, 5%
R5033	315-0333-00			33 kΩ, 1/4 W, 5%
R5042	315-0153-00			15 kΩ, 1/4 W, 5%
R5044	315-0241-00			240 Ω, 1/4 W, 5%
R5046	315-0272-00			2.7 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5049	315-0562-00			5.6 kΩ, 1/4 W, 5%
R5050	315-0430-00			43 Ω, 1/4 W, 5%
R5052	315-0102-00			1 kΩ, 1/4 W, 5%
R5055	315-0752-00			7.5 kΩ, 1/4 W, 5%
R5060	315-0391-00			390 Ω, 1/4 W, 5%
R5065	315-0241-00			240 Ω, 1/4 W, 5%
R5070	315-0100-00			10 Ω, 1/4 W, 5%
R5074	315-0102-00			1 kΩ, 1/4 W, 5%
R5075	315-0113-00			11 kΩ, 1/4 W, 5%
R5076	315-0153-00			15 kΩ, 1/4 W, 5%
R5080	315-0274-00			270 kΩ, 1/4 W, 5%
R5081	315-0914-00			910 kΩ, 1/4 W, 5%
R5089	315-0473-00			47 kΩ, 1/4 W, 5%
R5115	315-0331-00			330 Ω, 1/4 W, 5%
R5131	315-0103-00			10 kΩ, 1/4 W, 5%
R5135	315-0470-00			47 Ω,1/4 W, 5%
R5138	315-0271-00			270 Ω, 1/4 W, 5%
R5140	315-0433-00			43 kΩ, 1/4 W, 5%
R5155	315-0432-00			4.3 kΩ, 1/4 W, 5%
R5157	315-0153-00			15 kΩ, 1/4 W, 5%
R5160	321-0338-00			32.4 kΩ, 1/8 W, 1%
R5162	315-0243-00			24 kΩ, 1/4 W, 5%
R5165	315-0103-00			10 kΩ, 1/4 W, 5%
R5175	315-0153-00			15 kΩ, 1/4 W, 5%
R5178	315-0393-00			39 kΩ, 1/4 W, 5%
R5185	315-0301-00			300 Ω, 1/4 W, 5%
R5193	315-0274-00			270 kΩ, 1/4 W, 5%
R5215	315-0361-00			360 Ω, 1/4 W, 5%
R5218	315-0183-00			18 kΩ, 1/4 W, 5%
R5220	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5240	315-0153-00			15 kΩ, 1/4 W, 5%
R5245	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5247	315-0561-00			560 Ω, 1/4 W, 5%
R5249	315-0361-00			360 Ω, 1/4 W, 5%
R5260	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5265	315-0332-00			3.3 kΩ, 1/4 W, 5%
R5268	315-0561-00			560 Ω, 1/4 W, 5%
R5269	315-0361-00			360 Ω, 1/4 W, 5%
R5270	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5285	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5315	315-0153-00			15 kΩ, 1/4 W, 5%
R5325	321-0181-00			750 Ω, 1/8 W, 1%
R5345	315-0361-00			360 Ω, 1/4 W, 5%
R5348	315-0153-00			15 kΩ, 1/4 W, 5%
R5350	321-0281-00			8.25 kΩ, 1/8 W, 1%
R5355	321-0281-00			8.25 kΩ, 1/8 W, 1%
R5357	315-0242-00			2.4 kΩ, 1/4 W, 5%
R5360	315-0102-00			1 kΩ, 1/4 W, 5%
R5362	315-0102-00			1 kΩ, 1/4 W, 5%
R5370	315-0102-00			1 kΩ, 1/4 W, 5%
R5375	315-0623-00			62 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5380	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5385	315-0102-00			1 kΩ, 1/4 W, 5%
R5398	315-0103-00			10 kΩ, 1/4 W, 5%
R5401	321-0181-00			750 Ω, 1/8 W, 1%
R5420	315-0102-00			1 kΩ, 1/4 W, 5%
R5425	315-0102-00			1 kΩ, 1/4 W, 5%
R5430	315-0122-00			1.2 kΩ, 1/4 W, 5%
R5440	315-0361-00			360 Ω, 1/4 W, 5%
R5442	315-0153-00			15 kΩ, 1/4 W, 5%
R5455	315-0181-00			180 Ω, 1/4 W, 5%
R5461	315-0473-00			47 kΩ, 1/4 W, 5%
R5465	321-0193-00			1 kΩ, 1/8 W, 1%
R5470	315-0153-00			15 kΩ, 1/4 W, 5%
R5472	321-0193-00			1 kΩ, 1/8 W, 1%
R5474	315-0153-00			15 kΩ, 1/4 W, 5%
R5476	315-0153-00			15 kΩ, 1/4 W, 5%
R5490	315-0102-00			1 kΩ, 1/4 W, 5%
R5520	315-0330-00			33 Ω, 1/4 W, 5%
R5525	315-0122-00			1.2 kΩ, 1/4 W, 5%
R5530	315-0101-00			100 Ω, 1/4 W, 5%
R5540	315-0181-00			180 Ω, 1/4 W, 5%
R5542	315-0242-00			2.4 kΩ, 1/4 W, 5%
R5545	315-0101-00			100 Ω, 1/4 W, 5%
R5550	315-0101-00			100 Ω, 1/4 W, 5%
R5560	315-0101-00			100 Ω, 1/4 W, 5%
R5562	315-0101-00			100 Ω, 1/4 W, 5%
R5570	315-0473-00			47 kΩ, 1/4 W, 5%
R5575	315-0470-00			47 Ω, 1/4 W, 5%
R5580	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5582	315-0303-00			30 kΩ, 1/4 W, 5%
R5584	315-0151-00			150 Ω, 1/4 W, 5%
R5590	315-0201-00			200 Ω, 1/4 W, 5%
R5595	315-0151-00			150 Ω, 1/4 W, 5%
R5610	315-0331-00			330 Ω, 1/4 W, 5%
R5618	315-0101-00			100 Ω, 1/4 W, 5%
R5635	321-0193-00			1 kΩ, 1/8 W, 1%
R5640	321-0193-00			1 kΩ, 1/8 W, 1%
R5642	315-0363-00			36 kΩ, 1/4 W, 5%
R5665	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5670	315-0153-00			15 kΩ, 1/4 W, 5%
R5672	315-0153-00			15 kΩ, 1/4 W, 5%
R5685	315-0201-00			200 Ω, 1/4 W, 5%
R5701	315-0100-00			10 Ω, 1/4 W, 5%
R5710	315-0153-00			15 kΩ, 1/4 W, 5%
R5720	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5722	315-0433-00			43 kΩ, 1/4 W, 5%
R5735	315-0753-00			75 kΩ, 1/4 W, 5%
R5740	315-0154-00			150 kΩ, 1/4 W, 5%
R5742	315-0754-00			750 kΩ, 1/4 W, 5%
R5744	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5746	315-0512-00			5.1 kΩ, 1/4 W, 5%

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ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Description
RESISTORS (cont)				
R5750	315-0823-00			82 kΩ, 1/4 W, 5%
R5755	315-0104-00			100 kΩ, 1/4 W, 5%
R5758	316-0825-00			8.2 MΩ, 1/4 W, 5%
R5760	315-0102-00			1 kΩ, 1/4 W, 5%
R5770	315-0473-00			47 kΩ, 1/4 W, 5%
R5772	315-0751-00			750 Ω, 1/4 W, 5%
R5775	315-0104-00			100 kΩ, 1/4 W, 5%
R5780	315-0243-00			24 kΩ, 1/4 W, 5%
R5781	315-0391-00			390 Ω, 1/4 W, 5%
R5784	321-0371-00			71.5 kΩ, 1/8 W, 1%
R5785	321-0331-00			27.4 kΩ, 1/8 W, 1%
R5788	321-0318-00			20 kΩ, 1/4 W, 1%
R5790	315-0473-00			47 kΩ, 1/4 W, 5%
R5792	321-0371-00			71.5 kΩ, 1/8 W, 1%
R5794	321-0318-00			20 kΩ, 1/8 W, 1%
R5798	315-0473-00			47 kΩ, 1/4 W, 5%
R5801	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5818	315-0101-00			100 Ω, 1/4 W, 5%
R5820	315-0222-00			2.2 kΩ, 1/4 W, 5%
R5825	315-0103-00			10 kΩ, 1/4 W, 5%
R5830	315-0220-00			22 kΩ, 1/4 W, 5%
R5832	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5834	315-0750-00			75 Ω, 1/4 W, 5%
R5840	315-0124-00			120 kΩ, 1/4 W, 5%
R5841	315-0622-00			6.2 kΩ, 1/4 W, 5%
R5845	315-0272-00			2.7 kΩ, 1/4 W, 5%
R5865	315-0103-00			10 kΩ, 1/4 W, 5%
R5868	315-0103-00			10 kΩ, 1/4 W, 5%
R5870	315-0475-00			4.7 MΩ, 1/4 W, 5%
R5872	321-0252-00			4.12 kΩ, 1/8 W, 1%
R5875	321-0220-00			1.91 kΩ, 1/8 W, 1%
R5877	315-0682-00			6.8 kΩ, 1/4 W, 5%
R5878	321-0335-00			30.1 kΩ, 1/8 W, 1%
R5880	321-0705-00			41.7 kΩ, 1/8 W, 1%
R5882	315-0474-00			470 kΩ, 1/4 W, 5%
R5884	321-0335-00			30.1 kΩ, 1/8 W, 1%
R5890	321-0331-00			27.4 kΩ, 1/8 W, 1%
R5892	321-0705-00			41.7 kΩ, 1/8 W, 1%
R5910	321-0277-00			7.5 kΩ (nominal value) selected
R5920	321-0231-00			2.49 kΩ, (nominal value) selected
R5929	311-1267-00			5 kΩ, Var
R5933	315-0202-00			2 kΩ, 1/4 W, 5%
R5935	315-0124-00			120 kΩ, 1/4 W, 5%
R5940	315-0473-00			47 kΩ, 1/4 W, 5%
R5945	315-0393-00			39 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5950	315-0202-00			2 kΩ, 1/4 W, 5%
R5965	315-0333-00			33 kΩ, 1/4 W, 5%
R5968	315-0153-00			15 kΩ, 1/4 W, 5%
R5970	315-0104-00			100 kΩ, 1/4 W, 5%
R5975	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5990	315-0392-00			3.9 kΩ, 1/4 W, 5%
R5994	321-0306-00			15 kΩ, 1/8 W, 1%
R5998	321-0373-00			75 kΩ, 1/8 W, 1%
R6005	315-0472-00			4.7 kΩ, 1/4 W, 5%
R6008	315-0103-00			10 kΩ, 1/4 W, 5%
R6071	315-0470-00			47 Ω, 1/4 W, 5%
R6075	315-0470-00			47 Ω, 1/4 W, 5%
R6082	315-0270-00			27 Ω, 1/4 W, 5%
R6083	315-0202-00			2 kΩ, 1/4 W, 5%
R6086	315-0100-00			10 Ω, 1/4 W, 5%
R6098	315-0302-00			3 kΩ, 1/4 W, 5%
R6108	315-0103-00			10 kΩ, 1/4 W, 5%
R6117	321-0354-00			47.5 kΩ, 1/8 W, 1%
R6119	321-0277-00			7.5 kΩ, 1/8 W, 1%
R6122	321-0279-00			7.87 kΩ, 1/8 W, 1%
R6128	321-0233-00			2.61 kΩ, 1/8 W, 1%
R6132	321-0247-00			3.65 kΩ, 1/8 W, 1%
R6136	321-0229-00			2.37 kΩ, 1/8 W, 1%
R6142	321-0406-00			165 kΩ, 1/8 W, 1%
R6144	321-0215-00			1.69 kΩ, 1/8 W, 1%
R6148	315-0103-00			10 kΩ, 1/4 W, 5%
R6152	315-0102-00			1 kΩ,1/4 W, 5%
R6154	315-0103-00			10 kΩ, 1/4 W, 5%
R6158	322-0205-00			1.33 kΩ, 1/4 W, 1%
R6164	323-0176-00			665 Ω, 1/2 W, 1%
R6195	315-0202-00			2 kΩ, 1/4 W, 5%
R6202	311-1269-00			20 kΩ, Var
R6249	321-0394-00			124 kΩ, 1/8 W, 1%
R6284	315-0100-00			10 Ω, 1/4 W, 5%
R6288	315-0332-00			3.3 kΩ, 1/4 W, 5%
R6304	311-1269-00			20 kΩ, Var
R6314	311-1267-00			5 kΩ, Var
R6324	311-1267-00			5 kΩ, Var
R6334	311-1266-00			2.5 kΩ, Var
R6344	311-1266-00			2.5 kΩ, Var
R6354	311-1271-00			50 kΩ, Var
R6362	311-1273-00			200 kΩ, Var
R6364	315-0104-00			100 kΩ, 1/4 W, 5%
R6368	321-0829-07			202 Ω, 1/8 W, 1/10%
R6370	321-0829-07			202 Ω, 1/8 W, 1/10%
R6384	315-0162-00			1.6 kΩ, 1/4 W, 5%
R6392	315-0102-00			1 kΩ, 1/4 W, 5%
R6395	315-0102-00			1 kΩ, 1/4 W, 5%
R6398	315-0391-00			390 Ω, 1/4 W, 5%
R6448	321-0130-00			221 Ω, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R6458	311-1263-00			1 kΩ, Var
R6463	315-0104-00			100 kΩ, 1/4 W, 5%
R6467	315-0153-00			15 kΩ, 1/4 W, 5%
R6468	315-0622-00			6.2 kΩ, 1/4 W, 5%
R6472	315-0203-00			20 kΩ, 1/4 W, 5%
R6474	315-0222-00			2.2 kΩ, 1/4 W, 5%
R6504	321-0222-00			2 kΩ, 1/8 W, 1%
R6506	321-0319-00			20.5 kΩ, 1/8 W, 1%
R6508	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6512	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6514	321-0252-00			4.12 kΩ, 1/8 W, 1%
R6516	321-0219-00			1.87 kΩ, 1/8 W, 1%
R6518	321-0240-00			3.09 kΩ, 1/8 W, 1%
R6522	321-0182-00			768 Ω, 1/8 W, 1%
R6524	321-0246-00			3.57 kΩ, 1/8 W, 1%
R6526	321-0130-00			221 Ω, 1/8 W, 1%
R6528	321-0222-00			2 kΩ, 1/8 W, 1%
R6531	321-0319-00			20.5 kΩ, 1/8 W, 1%
R6533	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6535	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6537	321-0252-00			4.12 kΩ, 1/8 W, 1%
R6539	321-0219-00			1.87 kΩ, 1/8 W, 1%
R6542	321-0240-00			3.09 kΩ, 1/8 W, 1%
R6544	321-0182-00			768 Ω, 1/8 W, 1%
R6548	321-0246-00			3.57 kΩ, 1/8 W, 1%
R6552	321-0155-00			402 Ω, 1/8 W, 1%
R6555	321-0256-00			4.53 kΩ, 1/8 W, 1%
R6558	321-0287-00			9.53 kΩ, 1/8 W, 1%
R6562	315-0101-00			100 Ω, 1/4 W, 5%
R6563	315-0224-00			220 kΩ, 1/4 W, 5%
R6564	315-0103-00			10 kΩ, 1/4 W, 5%
R6566	315-0223-00			22 kΩ, (nominal value), selected
R6578	315-0271-00			270 Ω, 1/4 W, 5%
R6579	315-0182-00			1.8 kΩ, 1/4 W, 5%
R6582	315-0272-00			2.7 kΩ, 1/4 W, 5%
R6584	315-0362-00			3.6 kΩ, 1/4 W, 5%
R6586	315-0181-00			180 Ω, 1/4 W, 5%
R6612	315-0271-00			270 Ω, 1/4 W, 5%
R6614	315-0271-00			270 Ω, 1/4 W, 5%
R6634	321-0197-00			1.1 kΩ, 1/8 W, 1%
R6638	321-0212-00			1.58 kΩ, 1/8 W, 1%
R6642	321-0235-00			2.74 kΩ, 1/8 W, 1%
R6646	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6648	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6663	321-0306-00			15 kΩ, 1/8 W, 1%
R6668	315-0332-00			3.3 kΩ, 1/4 W, 5%
R6673	311-1265-00			2 kΩ, Var
R6677	321-0303-00			14 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R6684	315-0272-00			2.7 kΩ, 1/4 W, 5%
R6689	321-0300-00			13 kΩ, 1/8 W, 1%
R6724	321-0258-00			52.3 kΩ, 1/8 W, 1%
R6736	311-1271-00			50 kΩ, Var
R6741	311-1263-00			1 kΩ, Var
R6758	315-0102-00			1 kΩ, 1/4 W, 5%
R6782	315-0102-00			1 kΩ, (nominal value) selected
R6791	321-0277-00			7.5 kΩ, 1/8 W, 1%
R6793	315-0102-00			1 kΩ, (nominal value) selected
R6798	321-0230-00			2.43 kΩ, 1/8 W, 1%
R6833	311-1266-00			2.5 kΩ, Var
R6836	311-1266-00			2.5 kΩ, Var
R6842	321-0271-00			6.49 kΩ, 1/8 W, 1%
R6844	321-0242-00			3.24 kΩ, 1/8 W, 1%
R6848	315-0102-00			1 kΩ, 1/4 W, 5%
R6859	315-0302-00			3 kΩ, 1/4 W, 5%
R6860	321-0260-00			4.99 kΩ, 1/8 W, 1%
R6864	308-0252-00			390 Ω, 3 W, WW, 5%
R6866	315-0221-00			220 Ω, 1/4 W, 5%
R6868	321-0222-00			2 kΩ, 1/8 W, 1%
R6875	315-0102-00			1 kΩ, 1/4 W, 5%
R6883	315-0100-00			10 Ω, 1/4 W, 5%
R6892	315-0472-00			4.7 kΩ, 1/4 W, 5%
R6898	311-1260-00			250 Ω, Var
R6904	315-0100-00			10 Ω, 1/4 W, 5%
R6910	321-0341-00			34.8 kΩ, 1/8 W, 1%
R6912	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6920	321-0309-00			16.2 kΩ, 1/8 W, 1%
R6926	321-0357-00			51.1 kΩ, 1/8 W, 1%
R6938	311-1269-00			20 kΩ, Var
R6942	311-1263-00			1 kΩ, Var
R6944	321-0068-00			49.9 Ω, 1/8 W, 1%
R6956	315-0510-00			51 Ω, 1/4 W, 5%
R6977	311-1260-00			250 Ω, Var
R6981	315-0103-00			10 kΩ, 1/4 W, 5%
R6983	321-0277-00			7.5 kΩ, 1/8 W, 1%
R6992	315-0100-00			10 Ω, 1/4 W, 5%
R6996	321-0277-00			7.5 kΩ, 1/8 W, 1%
R7005	315-0102-00			1 kΩ, 1/4 W, 5%
R7030	315-0153-00			15 kΩ, 1/4 W, 5%
R7034	315-0752-00			7.5 kΩ, 1/4 W, 5%
R7051	315-0472-00			4.7 kΩ, 1/4 W, 5%
R7131	311-1228-00			10 kΩ, Var
R7138	311-1228-00			10 kΩ, Var
R7143	311-1263-00			1 kΩ, Var
R7181	315-0203-00			20 kΩ, 1/4 W, 5%
R7215	315-0181-00			180 Ω, 1/4 W, 5%
R7236	315-0103-00			10 kΩ, 1/4 W, 5%
R7237	315-0362-00			3.6 kΩ, 1/4 W, 5%
R7238	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7240	315-0101-00			100 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R7241	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7261	315-0472-00			4.7 kΩ, 1/4 W, 5%
R7331	315-0101-00			100 Ω, 1/4 W, 5%
R7333	315-0152-00			1.5 kΩ, 1/4 W, 5%
R7341	315-0302-00			3 kΩ, 1/4 W, 5%
R7351	315-0272-00			2.7 kΩ, 1/4 W, 5%
R7353	315-0152-00			1.5 kΩ, 1/4 W, 5%
R7355	315-0272-00			2.7 kΩ, 1/4 W, 5%
R7357	311-1225-00			1 kΩ, Var
R7361	311-0613-00			100 kΩ, Var
R7371	315-0101-00			100 Ω, 1/4 W, 5%
R7381	315-0101-00			100 Ω, 1/4 W, 5%
R7383	315-0105-00			1 MΩ, 1/4 W, 5%
R7385	315-0104-00			100 kΩ, 1/4 W, 5%
R7441	315-0102-00			1 kΩ, 1/4 W, 5%
R7443	321-0242-00			3.24 kΩ,1/8 W, 1%
R7445	321-0305-00			14.7 kΩ, 1/8 W, 1%
R7453	311-1227-00			5 kΩ, Var
R7461	321-0269-00			6.19 kΩ, 1/8 W, 1%
R7491	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7492	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7541	321-0373-00			75 kΩ, 1/8 W, 1%
R7542	315-0102-00			1 kΩ, 1/4 W, 5%
R7546	315-0100-00			10 Ω, 1/4 W, 5%
R7551	321-0241-00			3.16 kΩ, 1/8 W, 1%
R7553	321-0241-00			3.16 kΩ, 1/8 W, 1%
R7581	321-0269-00			6.19 kΩ, 1/8 W, 1%
R7591	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7615	311-0634-00			500 Ω, Var
R7661	311-1263-00			1 kΩ, Var
R7685	321-0181-00			750 Ω, 1/8 W, 1%
R7691	321-0235-00			2.74 kΩ, 1/8 W, 1%
R7711	321-0164-00			499 Ω, 1/8 W, 1%
R7721	321-0101-00			110 Ω, (nominal value) selected
R7723	321-0172-00			604 Ω, 1/8 W, 1%
R7725	321-0097-00			100 Ω, 1/8 W, 1%
R7727	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7729	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7731	321-0126-00			200 Ω, 1/8 W, 1%
R7733	**321-1223-00**			250 Ω, Var
R7735	311-1223-00			250 Ω, Var
R7751	321-0272-00			6.65 kΩ, 1/8 W, 1%
R7761	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7763	315-0911-00			910 Ω, 1/4 W, 5%
R7781	315-0101-00			100 Ω, 1/4 W, 5%
R7841	321-0219-00			1.87 kΩ, 1/8 W, 1%
R7843	321-0189-00			909 Ω, 1/8 W, 1%
R7851	321-0222-00			2 kΩ, 1/8 W, 1%
R7853	308-0252-00			390 Ω, 3W, WW, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R7891	315-0302-00			3 kΩ, 1/4 W, 5%
R7893	315-0470-00			47 Ω, 1/4 W, 5%
R7901	315-0681-00			680 Ω, 1/4 W, 5%
R7911	315-0242-00			2.4 kΩ, 1/4 W, 5%
R7912	315-0221-00			220 Ω, 1/4 W, 5%
R7913	321-0210-00			1.5 kΩ, 1/8 W, 1%
R7915	321-0210-00			1.5 kΩ, 1/8 W, 1%
R7921	308-0252-00			390 Ω, 3 W, WW, 5%
R7923	321-0114-07			150 Ω, 1/8 W, 1/10%
R7931	321-0114-07			150 Ω, 1/8 W, 1/10%
R7933	321-0114-07			150 Ω, 1/8 W, 1/10%
R7935	321-0114-07			150 Ω, 1/8 W, 1/10%
R7941	321-0114-07			150 Ω, 1/8 W, 1/10%
R7943	321-0114-07			150 Ω, 1/8 W, 1/10%
R7951	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7953	301-0821-00			820 Ω, 1/2 W, 5%
R7955	321-0085-00			75 Ω, 1/8 W, 1%
R7961	321-0105-00			121 Ω, 1/8 W, 1%
R7963	321-0097-00			100 Ω, 1/8 W, 1%
R7971	315-0302-00			3 kΩ, 1/4 W, 5%
R7973	321-0068-00			49.9 Ω, 1/8 W, 1%
R7981	321-0239-00			3.01 kΩ, 1/8 W, 1%
R7983	321-0068-00			49.9 Ω, 1/8 W, 1%
R7991	315-0202-00			2 kΩ, 1/4 W, 5%
R7993	311-1221-00			50 Ω, Var
R7995	315-0470-00			47 Ω, 1/4 W, 5%
R8001	315-0303-00			30 kΩ, 1/4 W, 5%
R8007	311-1258-00			50 Ω, Var
R8027	321-0217-03			1.78 kΩ, 1/8 W, 1/4%
R8029	315-0470-00			47 Ω, 1/4 W, 5%
R8037	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8053	315-0681-00			680 Ω, 1/4 W, 5%
R8059	315-0101-00			100 Ω, 1/4 W, 5%
R8077	321-0193-00			1 kΩ, 1/8 W, 1%
R8102	315-0470-00			47 Ω, 1/4 W, 5%
R8103	321-0812-07			544 Ω, 1/8 W, 1/10%
R8105	321-0258-00			4.75 kΩ, 1/8 W, 1%
R8107	321-0664-00			1.56 kΩ, 1/8 W, 1/2%
R8109	311-0633-00			5 kΩ, Var
R8127	315-0101-00			100 Ω, 1/4 W, 5%
R8129	321-0829-02			202 Ω, 1/8 W, 1/2%
R8135	311-1259-00			100 Ω, Var
R8137	321-0735-07			1 kΩ, 1/8 W, 1/10%
R8139	315-0470-00			47 Ω, 1/4 W, 5%
R8141	321-0812-07			455 Ω, 1/8 W, 1/10%
R8145	321-0812-07			455 Ω,1/8 W, 1/10%
R8153	315-0101-00			100 Ω, 1/4 W, 5%
R8155	315-0101-00			100 Ω, 1/4 W, 5%
R8203	321-0829-02			202 Ω, 1/8 W, 1/2%
R8204	321-0812-07			455 Ω, 1/8 W, 1/10%
R8205	321-0261-00			5.11 kΩ, 1/8 W, 1%

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ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R8207	321-0346-00			39.2 kΩ, 1/8 W, 1%
R8229	311-1259-00			100 Ω, Var
R8230	315-0102-00			1 kΩ, 1/4 W, 5%
R8231	321-0735-07			1 kΩ, 1/8 W, 1/10%
R8233	321-0735-07			1 kΩ, 1/8 W, 1/10%
R8235	321-0735-07			1 kΩ, 1/8 W, 1/10%
R8251	315-0470-00			47 Ω, 1/4 W, 5%
R8252	315-0470-00			47 Ω, 1/4 W, 5%
R8259	315-0101-00			100 Ω, 1/4 W, 5%
R8261	315-0101-00			100 Ω, 1/4 W, 5%
R8301	321-0193-00			1 kΩ, 1/8 W, 1%
R8303	321-0346-00			39.2 kΩ, 1/8 W, 1%
R8305	321-0193-00			1 kΩ, 1/8 W, 1%
R8327	321-0340-00			34 kΩ, 1/8 W, 1%
R8330	315-0102-00			1 kΩ, 1/4 W, 5%
R8331	321-0193-00			1 kΩ, 1/8 W, 1%
R8335	321-0812-07			455 Ω, 1/8 W, 1/10%
R8337	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8353	321-0812-07			455 Ω, 1/8 W, 1/10%
R8377	321-0125-00			196 Ω, 1/8 W, 1%
R8379	321-0125-00			196 Ω, 1/8 W, 1%
R8413	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8429	321-0193-00			1 kΩ, 1/8 W, 1%
R8433	321-0340-00			34 kΩ, 1/8 W, 1%
R8435	321-0193-00			1 kΩ, 1/8 W, 1%
R8451	315-0122-00			1.2 kΩ, 1/4 W, 5%
R8453	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8457	321-0154-00			392 Ω, 1/8 W, 1%
R8487	315-0752-00			7.5 kΩ, 1/4 W, 5%
R8531	315-0470-00			47 Ω, 1/4 W, 5%
R8553	315-0101-00			100 Ω, 1/4 W, 5%
R8555	315-0101-00			100 Ω, 1/4 W, 5%
R8557	315-0101-00			100 Ω, 1/4 W, 5%
R8579	315-0302-00			3 kΩ, 1/4 W, 5%
R8581	315-0202-00			2 kΩ, 1/4 W, 5%
R8583	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8585	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8601	315-0101-00			100 Ω, 1/4 W, 5%
R8607	321-0323-00			22.6 kΩ, 1/8 W, 1%
R8651	315-0101-00			100 Ω, 1/4 W, 5%
R8655	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8663	315-0101-00			100 Ω, 1/4 W, 5%
R8683	315-0102-00			1 kΩ, 1/4 W, 5%
R8705	311-1228-00			10 kΩ, Var
R8707	315-0102-00			1 kΩ,1/4 W, 5%
R8709	321-0323-00			22.6 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R8727	311-1228-00			10 kΩ, Var
R8731	315-0302-00			3 kΩ, 1/4 W, 5%
R8735	315-0101-00			100 Ω, 1/4 W, 5%
R8737	315-0102-00			1 kΩ, 1/4 W, 5%
R8753	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8777	315-0242-00			2.4 kΩ, 1/4 W, 5%
R8779	315-0201-00			200 Ω, 1/4 W, 5%
R8783	315-0752-00			7.5 kΩ, 1/4 W, 5%
R8785	321-0184-00			806 Ω, 1/8 W, 1%
R8793	321-0222-00			2 kΩ, 1/8 W, 1%
R8805	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8827	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8831	315-0203-00			20 kΩ, 1/4 W, 5%
R8833	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8835	315-0102-00			1 kΩ, 1/4 W, 5%
R8841	315-0242-00			2.4 kΩ, 1/4 W, 5%
R8847	315-0270-00			27 Ω, 1/4 W, 5%
R8853	315-0112-00			1.1 kΩ, 1/4 W, 5%
R8855	315-0153-00			15 kΩ, 1/4 W, 5%
R8859	315-0102-00			1 kΩ, 1/4 W, 5%
R8877	315-0112-00			1.1 kΩ, 1/4 W, 5%
R8879	321-0172-00			604 Ω, 1/8 W, 1%
R8883	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8885	315-0153-00			15 kΩ, 1/4 W, 5%
R8887	315-0104-00			100 kΩ, 1/4 W, 5%
R8891	315-0102-00			1 kΩ, 1/4 W, 5%
R8905	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8927	315-0203-00			20 kΩ, 1/4 W, 5%
R8929	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8939	311-1225-00			1 kΩ, Var
R8955	315-0470-00			47 Ω, 1/4 W, 5%
R9002	315-0153-00			15 kΩ, 1/4 W, 5%
R9080	302-0102-00			1 kΩ, 1/4 W, 5%
R9082	315-0153-00			15 kΩ, 1/4 W, 5%
R9205	311-1182-00			1.5 kΩ, Var
R9209	311-0326-00			10 kΩ, Var
R9210	311-0585-00			15 kΩ, Var
R9212	321-0085-00			75 Ω, 1/8 W, 1%
R9215	311-0310-00			5 kΩ, Var
R9280	311-0068-00			500 kΩ, Var
R9291	321-1170-03			583 Ω, 1/8 W, 1/4%
R9292-	321-0180-03			732 Ω, 1/8 W, 1/4%
R9293	321-0190-03			931 Ω, 1/8 W, 1/4%
R9294	321-0202-03			1.24 kΩ, 1/8 W, 1/4%
R9295	321-1216-03			1.76 kΩ, 1/8 W, 1/4%
R9296	321-0233-03			2.61 kΩ, 1/8 W, 1/4%
R9297	321-1254-03			4.37 kΩ, 1/8 W, 1/4%
R9298	321-1283-03			8.76 kΩ, 1/8 W, 1/4%
R9299	321-1329-03			26.4 kΩ, 1/8 W, 1/4%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R9800	315-0101-00			100 Ω, 1/4 W, 5%
R9801	311-1268-00			10 kΩ, Var
R9802	315-0101-00			100 Ω, 1/4 W, 5%
R9803	308-0344-00			18.2 Ω, 3 W, WW, 1%
R9804	308-0463-00			0.3 Ω, 3 W, WW, 1%
R9806	315-0431-00			430 Ω, 1/4 W, 5%
R9808	321-0197-00			1.1 kΩ, 1/8 W, 1%
R9810	321-0189-00			909 Ω, 1/8 W, 1%
R9812	315-0752-00			7.5 kΩ, 1/4 W, 5%
R9814	315-0101-00			100 Ω, 1/4 W, 5%
R9816	315-0471-00			470 Ω, 1/4 W, 5%
R9818	315-0751-00			750 Ω, 1/4 W, 5%
R9830	315-0101-00			100 Ω, 1/4 W, 5%
R9831	311-1268-00			10 kΩ, Var
R9832	308-0245-00			0.6 Ω, 2 W, WW, 5%
R9834	315-0101-00			100 Ω, 1/4 W, 5%
R9836	315-0431-00			430 Ω, 1/4 W, 5%
R9838	321-0224-00			2.1 kΩ, 1/8 W, 1%
R9840	321-0189-00			909 Ω, 1/8 W, 1%
R9842	315-0472-00			4.7 kΩ, 1/4 W, 5%
R9844	315-0471-00			470 Ω, 1/4 W, 5%
R9846	315-0301-00			300 Ω, 1/4 W, 5%
R9848	315-0182-00			1.8 kΩ, 1/4 W, 5%
R9850	315-0152-00			1.5 kΩ, 1/4 W, 5%
R9851	311-1268-00			10 kΩ, Var
R9852	315-0431-00			430 Ω, 1/4 W, 5%
R9854	321-0172-00			604 Ω, 1/8 W, 1%
R9856	321-0189-00			909 Ω, 1/8 W, 1%
R9858	321-0173-00			619 Ω, 1/8 W, 1%
R9860	315-0471-00			470 Ω, 1/4 W, 5%
R9862	315-0301-00			300 Ω, 1/4 W, 5%
R9864	315-0472-00			4.7 kΩ, 1/4 W, 5%
R9866	315-0101-00			100 Ω, 1/4 W, 5%
R9868	315-0101-00			100 Ω, 1/4 W, 5%
R9870	315-0331-00			330 Ω, 1/4 W, 5%
R9872	315-0392-00			3.9 kΩ, 1/4 W, 5%
R9874	308-0245-00			0.6 Ω, 2 W, WW, 5%
SWITCHES				
S9000	260-0583-01			Slide, SYNC SOURCE
S9201[1]	260-0276-00			Toggle, POWER
S9202[1]				
S9203[1]				
S9205	260-0731-00			Lever, UNITY GAIN/VAR
S9212	260-1248-00			Lever, REMOTE/LOCAL
S9213	260-1249-00			Lever, PROGRAM/PREVIEW/AUXILIARY

[1]See Mechanical Parts List. Line Voltage Selector.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SWITCHES (cont)				
S9225	260-1494-00			Lever, COLOR TEST SIGNAL
S9230	260-0731-00			Lever, COLOR TEST SIGNAL
S9250	260-0664-00			Lever, MULTIBURST AMPLITUDE
S9255	260-0731-00			Lever, LINEARITY SUBCARRIER
S9260	260-1250-00			Rotary, FULL FIELD SIG Mode
S9270	260-0621-00			Lever, LINEARITY Mode
S9285	260-0731-00			Lever, APL Mode
S9290	260-1374-00			Rotary, APL VARIABLE
TRANSFORMERS				
T8061	120-0524-00			Toroid, 12 turns, quadfilar
T8661	120-0631-00			Toroid, 10 turns, trifilar
T9001	120-0737-00			Power
INTEGRATED CIRCUITS				
U21	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U101	156-0114-00			Single 10 MHz divide-by-2-&-6 ripple counter, replaceable by SN7492N
U201	156-0072-00			Single monostable multivibrator-one shot, replaceable by SN74121N
U301	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U401	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U449	156-0092-00			Hex. inverter, replaceable by SN7405N
U499	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U761	155-0022-00			Monolithic, channel switch
U861	155-0022-00			Monolithic, channel switch
U1001	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1031	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1061	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1091	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1101	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1131	156-0034-00			Dual 4-input positive nand gate, replaceable by SN7420N
U1161	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1191	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1201	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1231	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1261	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U1291	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1301	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1331	156-0034-00			Dual 4-input positive nand gate, replaceable by SN7420N
U1361	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1391	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1431	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1461	156-0047-00			Triple 3-input positive nand gate, replaceable by SN7410N
U2001	156-0078-00			Single 1-out-of-16-line decoder/demultiplexer, replaceable by SN74154N
U2061	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2081	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2261	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2281	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2401	156-0078-00			Single 1-out-of-16-line decoder/demultiplexer, replaceable by SN74154N
U2461	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2481	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2666	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2681	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2721	156-0037-00			Dual 2-wide 2-input pos and/or/invert gate, replaceable by SN7451N
U2741	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2761	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2781	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2811	156-0172-00			Dual retriggerable monostable multivibrator, replaceable by SN74123N
U2831	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2861	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2881	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2911	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U2931	156-0058-00			Hex. inverter, replaceable by SN7404N
U2961	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2981	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N
U3210	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U3220	156-0089-00			Single 25 MHz sync 4-bit up/down counter, replaceable by SN74193N
U3230	156-0089-00			Single 25 MHz sync 4-bit up/down counter, replaceable by SN74193N
U3310	156-0178-00			Triple 3-input nor gate, replaceable by SN7427N
U3585	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U3735	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3755	156-0058-00			Hex. inverter, replaceable by SN7404N
U3775	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3835	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3855	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U3875	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4151	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4171	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4271	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U4351	156-0078-00			Single 1-out-of-16-line decoder/demultiplexer, replaceable by SN74154N
U4471	156-0032-00			Single 10 MHz 1-&-3-bit binary ripple counter, replaceable by SN7493N
U4551	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4571	156-0058-00			Hex. inverter, replaceable by SN7404N
U4621	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4641	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4661	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4681	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4721	156-0058-00			Hex. inverter, replaceable by SN7404N
U4741	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4761	156-0047-00			Triple 3-input positive nand gate, replaceable by SN7410N
U4781	156-0058-00			Hex. inverter, replaceable by SN7404N

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U4821	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U4841	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4861	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4881	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U6170	156-0048-00			Five NPN transistor array, replaceable by CA3046
U7251	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N
U7291	156-0067-00			Operational amplifier, replaceable by UA741C
U8151	156-0130-00			Balanced modulator/demodulator, replaceable by MC1496
U8255	156-0130-00			Balanced modulator/demodulator, replaceable by MC1496
U8977	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
CRYSTAL				
Y5639	158-0069-00			Crystal unit, 3.579545 MHz

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SECTION 7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

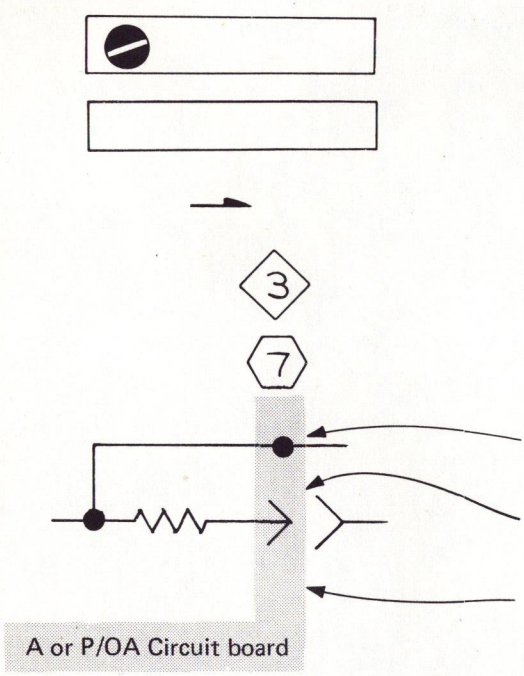
Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).
Resistors = Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1970.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

Circuit board assembly or part of circuit board assembly.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

VOLTAGE AND WAVEFORM CONDITIONS

Circuit voltages measured with a 20,000 Ω/volt VOM; all readings in volts. Voltages are measured with respect to chassis ground unless noted otherwise.

Waveforms shown are actual photographs taken with a TEKTRONIX Oscilloscope Camera System (TEKTRONIX Type 147 with 1A5 Plug-In Unit and C12 Camera). Test oscilloscope deflection factor and sweep rate conditions are noted on each waveform. DC coupling was used to obtain the DC levels that are recorded at the right side of each waveform. These DC levels are located with respect to the graticule rather than to the waveform. To indicate time relationship between signals, the test oscilloscope was triggered externally, where possible. The triggering source, except where noted, was COMPOSITE SYNC. Unless noted otherwise, the test oscilloscope was set for a delayed alternate sweep with the Delay Time Multiplier (DTM) set to view lines 20, 21, and 22 of field 1.

Voltages and Waveforms on the diagram (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration, etc.

WARNING

"Coaxial shields and ground lugs" are not always at ground potential. Check the diagram before using such connections as a ground for the VOM or test oscilloscope probe.

A TEKTRONIX Type 144 NTSC TEST SIGNAL GENERATOR was used to provide an external 1 volt peak to peak composite video color bar signal to the 149 PROGRAM LINE IN. The generator was set to provide a 50% APL VIT signal on line 20 of field 1.

Unless noted otherwise on each diagram, the 149 switches were set as follows:

POWER	ON
PROGRAM CONTROL	
UNITY GAIN/VAR	UNITY GAIN
PROGRAM/PREVIEW/AUXILIARY	PROGRAM
LOCAL/REMOTE	LOCAL
COLOR TEST SIGNAL	
Mode	COLOR BARS
Type	SPLIT FIELD
MULTIBURST AMPLITUDE	NORMAL
LINEARITY	
SUBCARRIER	ON
Mode	5 STEPS
FULL FIELD SIG	
Mode	SIN² PULSE AND BAR
APL	VAR
VARIABLE	100

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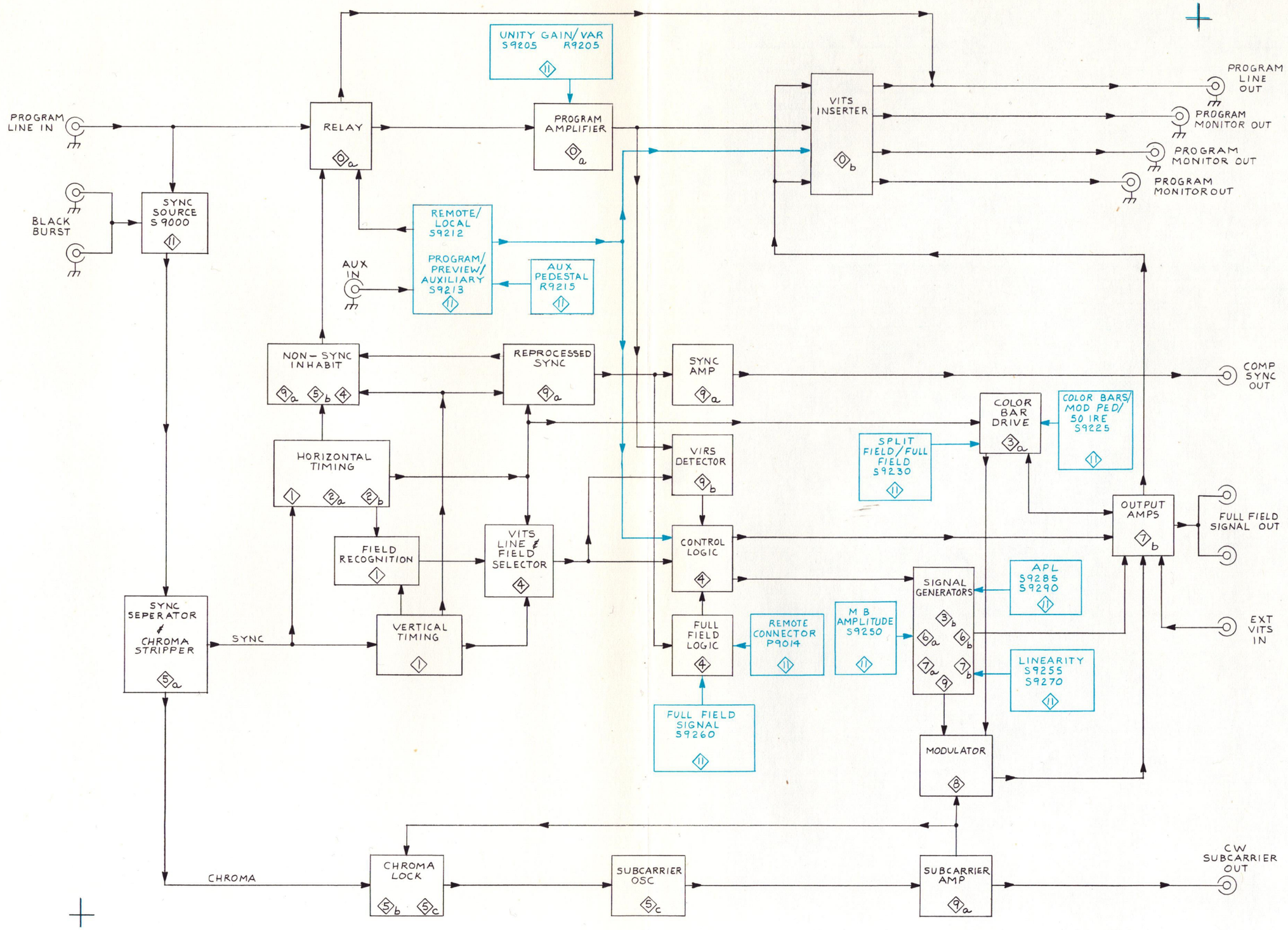
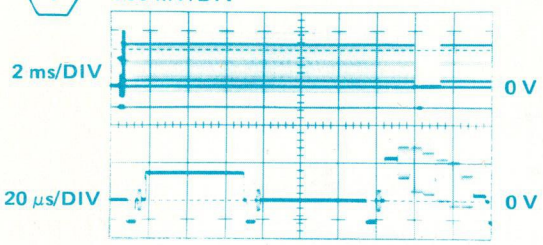


BLOCK DIAGRAM

MEB/DAJ
8-25-72

1



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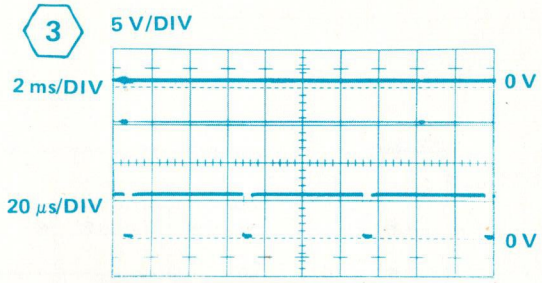

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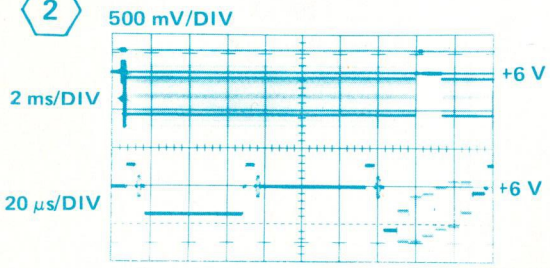
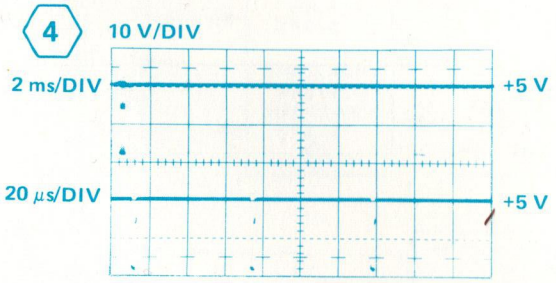
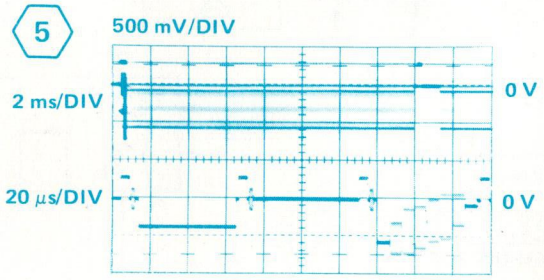


4

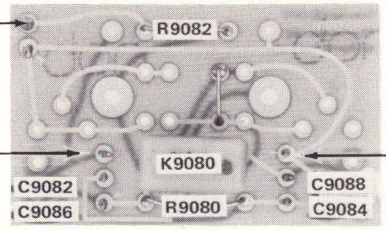


5



Waveforms and Voltages obtained under conditions given on the Diagram Title page.

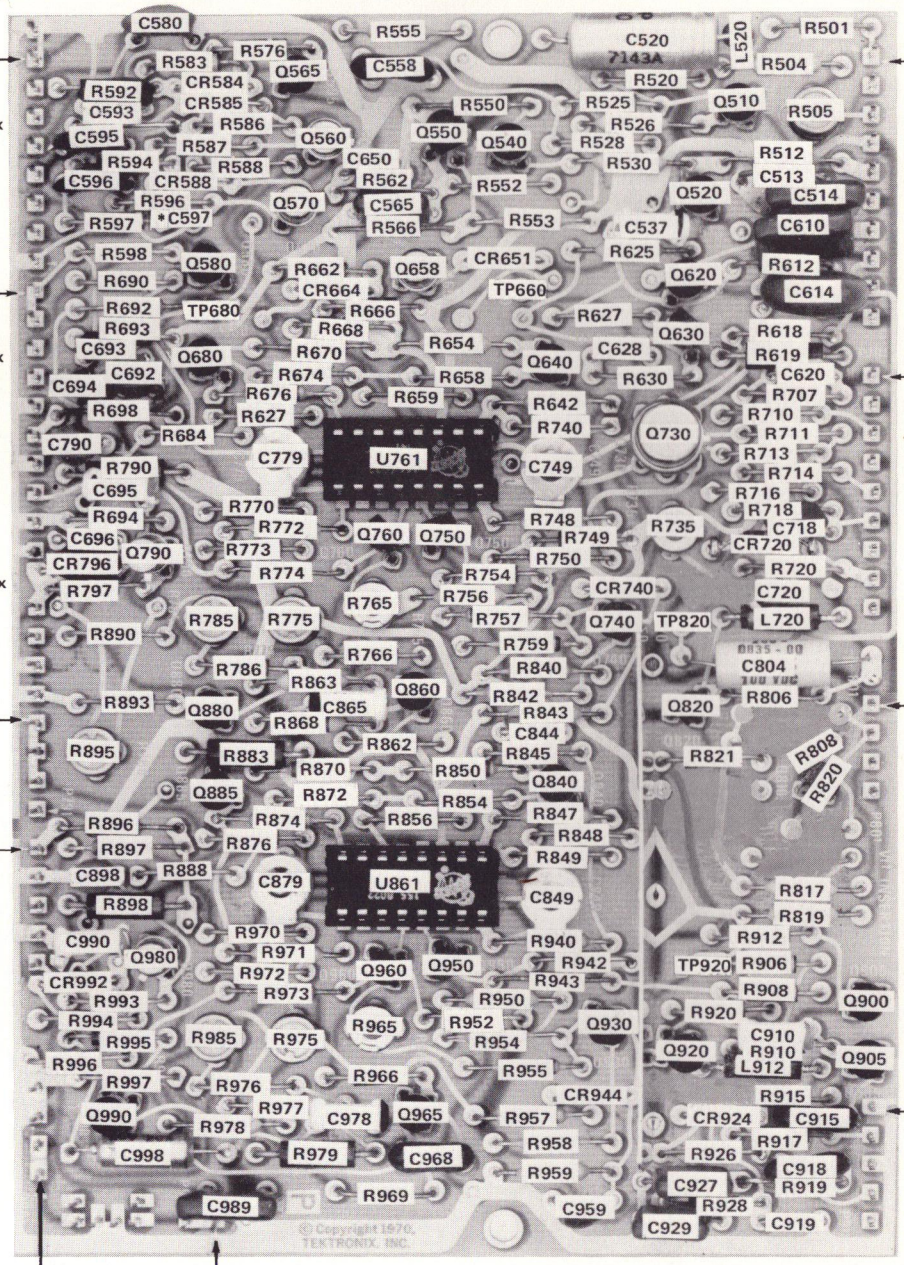
A11 RELAY Circuit Board Assembly



P9082
1
2 red-yel on wht

P9084
1 grn-gry on wht
2 blk coax
3 shield for 2

P9080
1 grn-vio on wht
2 blk coax
3 shield for 2



P591
1 shield for 3
2 blu-gry on wht
3 blk-gry on wht coax
4 blk
5 yel-blu on wht
6 red-yel on wht
7 blk coax
8 shield for 7
9 blk

P691
1
2 shield for 3
3 blk-gry on wht coax
4 shield for 5
5 vio on wht coax
6 shield for 7
7 blk coax
8 blk-blu on wht
9 grn-vio on wht
10 yel-vio on wht

P791
1 blu-gry on wht
2 blk-gry on wht coax
3 blk on wht coax
4 yel on wht coax
5
6
7
8

P891
1 blk on red
2 shield for 3
3 grn on wht coax
4 shield for 5
5 yel on wht coax

P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blue on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 blk-grn on wht coax
7 shield for 6
8 blk-blu on wht
9

P801
1 orn on wht
2
3 blk-red on wht
4 blk-brn on wht

P911
1 wht coax
2 shield for 2
3
4 blk
5 blk

P991
1 red on wht
2 red on wht
3 blk
4

P971
1 brn on wht
2 brn on wht

*See Parts List for serial number ranges.

AO VIT INSERTION Circuit Board Assembly

REV. B, AUG 1974

PROGRAM LINE AMPLIFIER 0a

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

WAVEFORMS

A11 RELAY CIRCUIT BOARD

PROGRAM LINE OUT

PROGRAM LINE IN

PROGRAM SIGNAL P691-7

P9080

J9007

J9009

K9080

C9084 .01

C9086 .01

R9080 1k

C9082 .01

P9084

RELAY CONTROL P301-1

R9082 15k

P9082

S9000 SYNC SOURCE

PROGRAM LINE IN OR BLACK BURST P5062-1

J9010 BLACK BURST

R9002 15k

J9008

S9212

P691

R598 100k

C693 .001

+5V

C692 68µF

Q580

R690 910

U761-6

R693 3.9k

-15V

C694 15µF

RELAY MODE INDICATOR

RELAY MODE P301-3

P591

C520 70µF

L520

Q510

R520 100

R555 75

C558 10

R525 33k

R526 2k

R530 2k

TP660

R552 100

Q540

-11.2V

R562 6.8k

C565 1µF

R550 374

R553 11.8k

R566 3.16

Q550

C650 0.1

P911

COMPOSITE SYNC P5294-3

R917 1k

L912 25µH

C915 150

CLAMP PULSE GENERATOR

GAIN

P501

R501 430

R504 665

R505 500 PROGRAM GAIN

R512 422

Q520

R528 220

P801

+15V R819 76.8k

-15V R817 73.2k

R9215 5k

AUXILIARY PEDESTAL

C9215 0.1

AUX IN

J9210

R9212 75

PROGRAM CONTROL SWITCHING

S9213 S9212

PROGRAM PREVIEW AUXILIARY

REMOTE LOCAL

PROGRAM SIGNAL P701-3

P701-5

P591-6

P691-9

P991

J9014-24

C9218 .01

P971

J9019-20

R9205 1.5k VAR

UNITY GAIN

S9205

(VAR) LEVEL

R619 680

R625 1.0k

R630 200

C628 0.1

TP820

C620 270

R707 56K

C804 .1

R720 47

R612 6.8k

C537 4.3

R627 100

Q630

Q620

CR720

C718 .001

R718 18k

R716 82k

R735 100k DIFF PHASE

TP801

P701

PROGRAM SIGNAL P490-9

CLAMP

L720 100µH

R806 1k

TP920

R906 6.8k

P911

C919 0.1

R928 220

R915 3.3k

R908 47

Q900

Q905

C910 100

C918 150

R912 2k

Q920

CR924

C929 1µF

R920 10

C822 .005

R820 470k

R808 4.7k

Q820

C927 1µF

R821 100

R919 15k

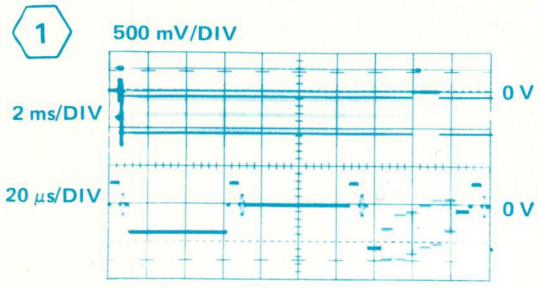
R910 3.3k

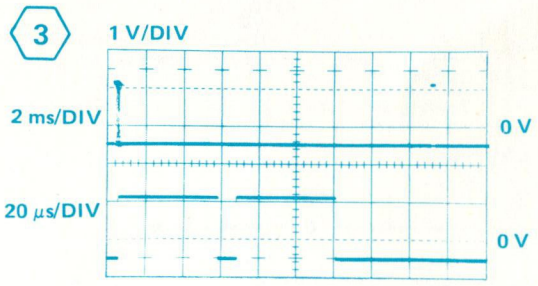
R926 56k

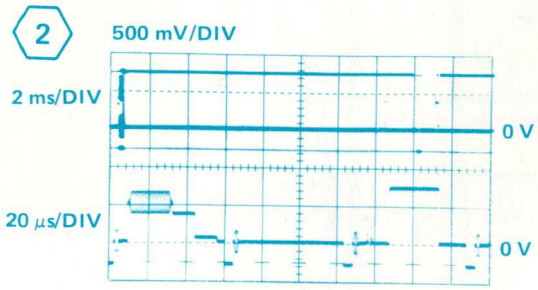
P/O A0 VITS INSERTION CIRCUIT BOARD

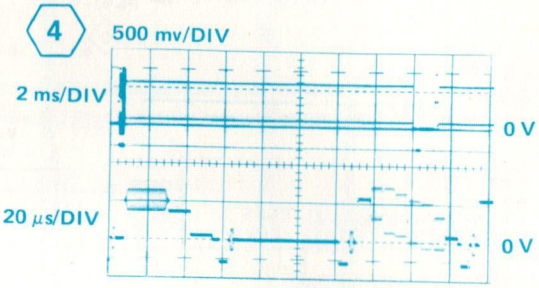
REV. B, AUG 1974

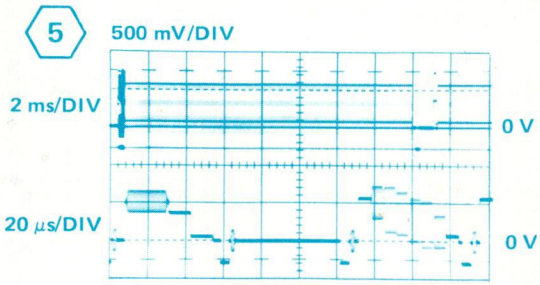
PROGRAM LINE AMPLIFIER ◇0a J. STORY





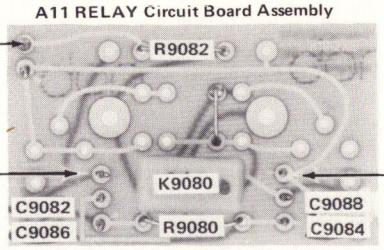






Waveforms and Voltages obtained under conditions given on the Diagram Title page.

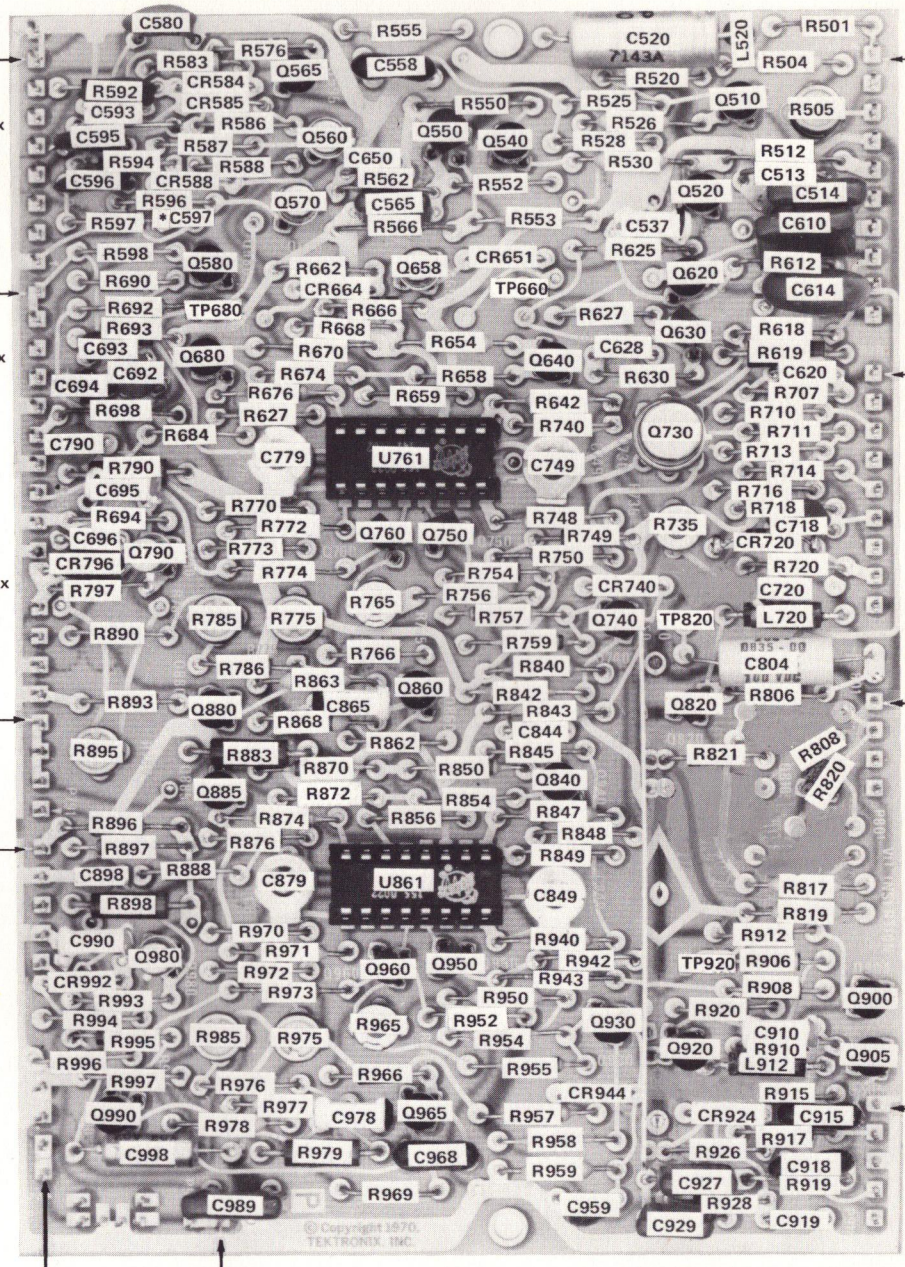
A11 RELAY Circuit Board Assembly



P9082
1
2 red-yel on wht

P9084
1 grn-gry on wht
2 blk coax
3 shield for 2

P9080
1 grn-vio on wht
2 blk coax
3 shield for 2



P591
1 shield for 3
2 blu-gry on wht
3 blk-gry on wht coax
4 blk
5 yel-blu on wht
6 red-yel on wht
7 blk coax
8 shield for 7
9 blk

P691
1
2 shield for 3
3 blk-gry on wht coax
4 shield for 5
5 vio on wht coax
6 shield for 7
7 blk coax
8 blk-blu on wht
9 grn-vio on wht
10 yel-vio on wht

P791
1 blu-gry on wht
2 blk-gry on wht coax
3 blk on wht coax
4 yel on wht coax
5
6
7
8

P891
1 blk on red
2 shield for 3
3 grn on wht coax
4 shield for 5
5 yel on wht coax

P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blue on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 blk-grn on wht coax
7 shield for 6
8 blk-blu on wht
9

P801
1 orn on wht
2
3 blk-red on wht
4 blk-brn on wht

P911
1 wht coax
2 shield for 2
3
4 blk
5 blk

P991
1 red on wht
2 red on wht
3 blk
4

P971
1 brn on wht
2 brn on wht

*See Parts List for serial number ranges.

AO VIT INSERTION Circuit Board Assembly

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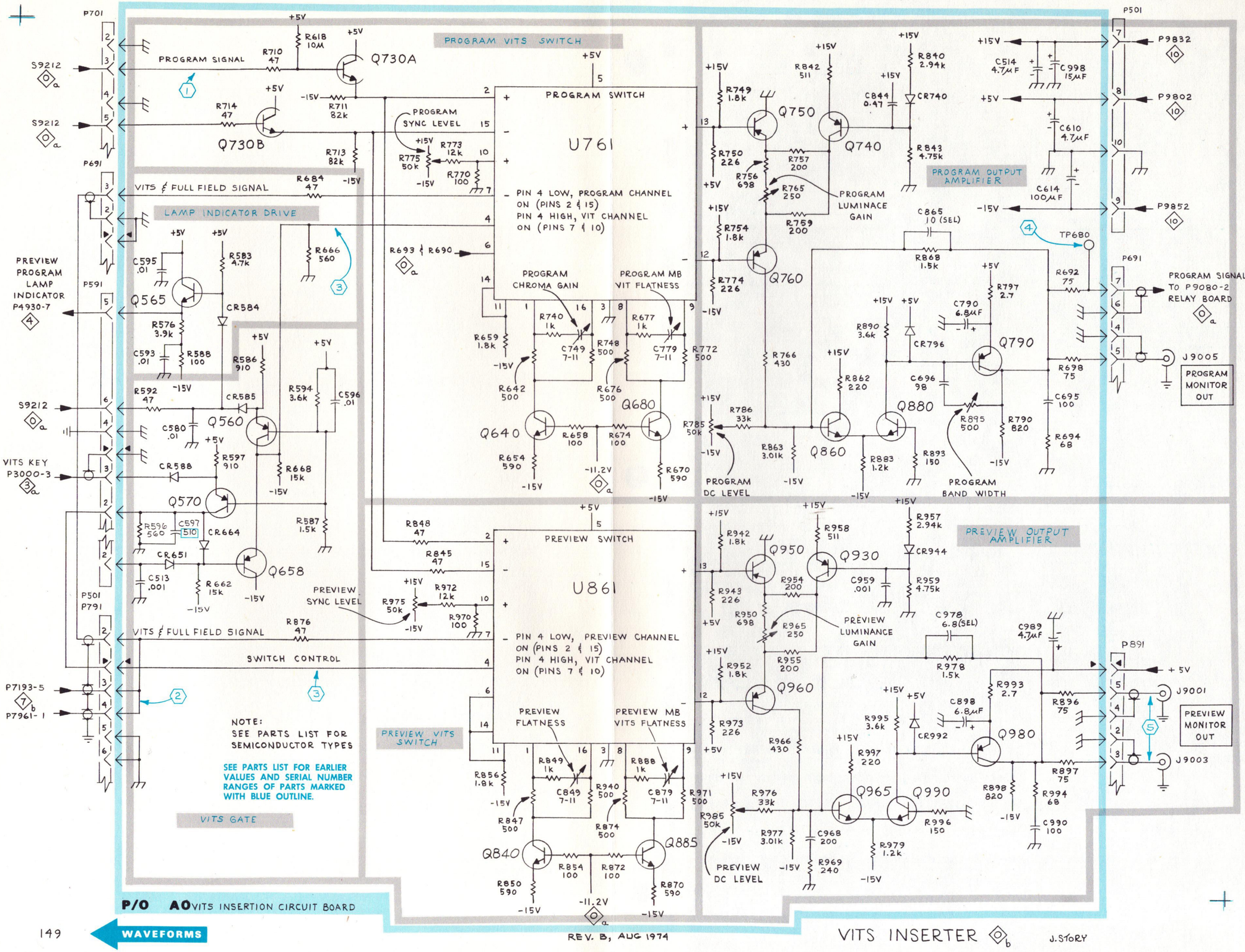
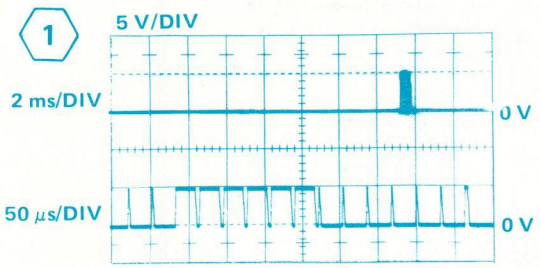
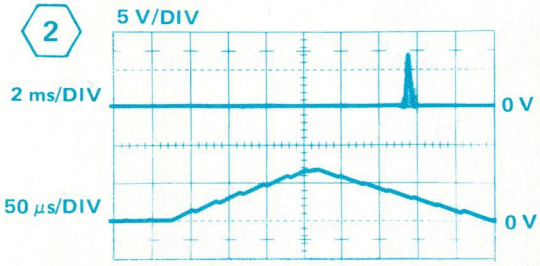
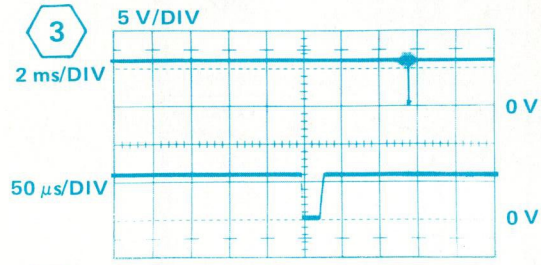
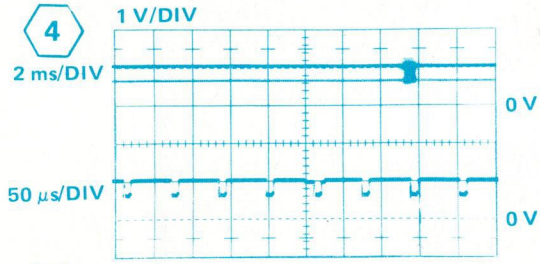
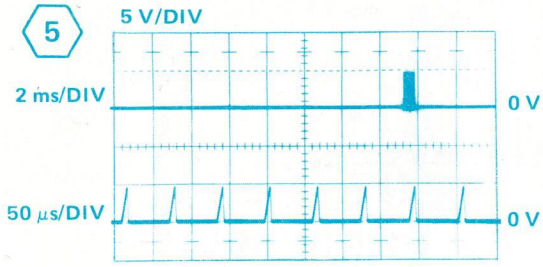

PROGRAM VITS SWITCH
PROGRAM SIGNAL
PROGRAM SWITCH
U761
PROGRAM SYNC LEVEL
PIN 4 LOW, PROGRAM CHANNEL ON (PINS 2 & 15)
PIN 4 HIGH, VIT CHANNEL ON (PINS 7 & 10)
VITS & FULL FIELD SIGNAL
LAMP INDICATOR DRIVE
PREVIEW PROGRAM LAMP INDICATOR P4930-7
PROGRAM CHROMA GAIN
PROGRAM MB VIT FLATNESS
PROGRAM OUTPUT AMPLIFIER
PROGRAM LUMINANCE GAIN
PROGRAM SIGNAL TO P9080-2 RELAY BOARD
PROGRAM MONITOR OUT
PROGRAM DC LEVEL
PROGRAM BAND WIDTH
VITS KEY P3000-3
PREVIEW SWITCH
U861
PREVIEW SYNC LEVEL
PIN 4 LOW, PREVIEW CHANNEL ON (PINS 2 & 15)
PIN 4 HIGH, VIT CHANNEL ON (PINS 7 & 10)
SWITCH CONTROL
PREVIEW FLATNESS
PREVIEW MB VITS FLATNESS
PREVIEW VITS SWITCH
PREVIEW OUTPUT AMPLIFIER
PREVIEW LUMINANCE GAIN
PREVIEW MONITOR OUT
PREVIEW DC LEVEL
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
VITS GATE
P/O A0 VITS INSERTION CIRCUIT BOARD
REV. B, AUG 1974
VITS INSERTER
J. STORY

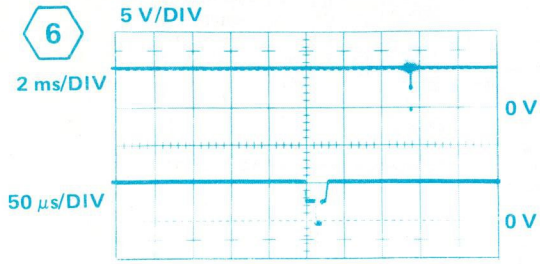


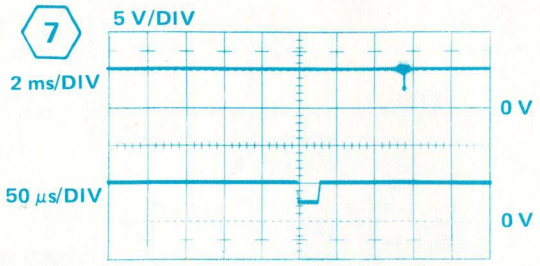


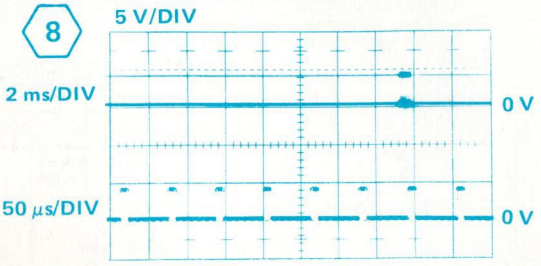


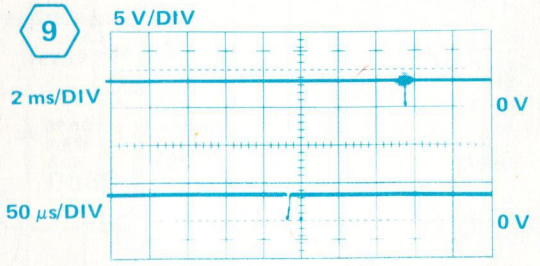


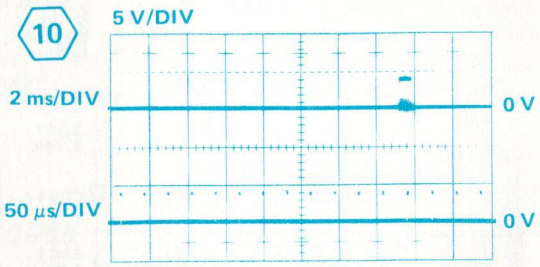


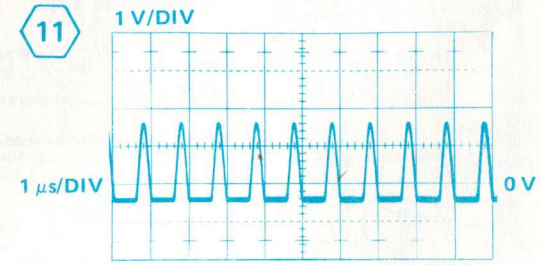




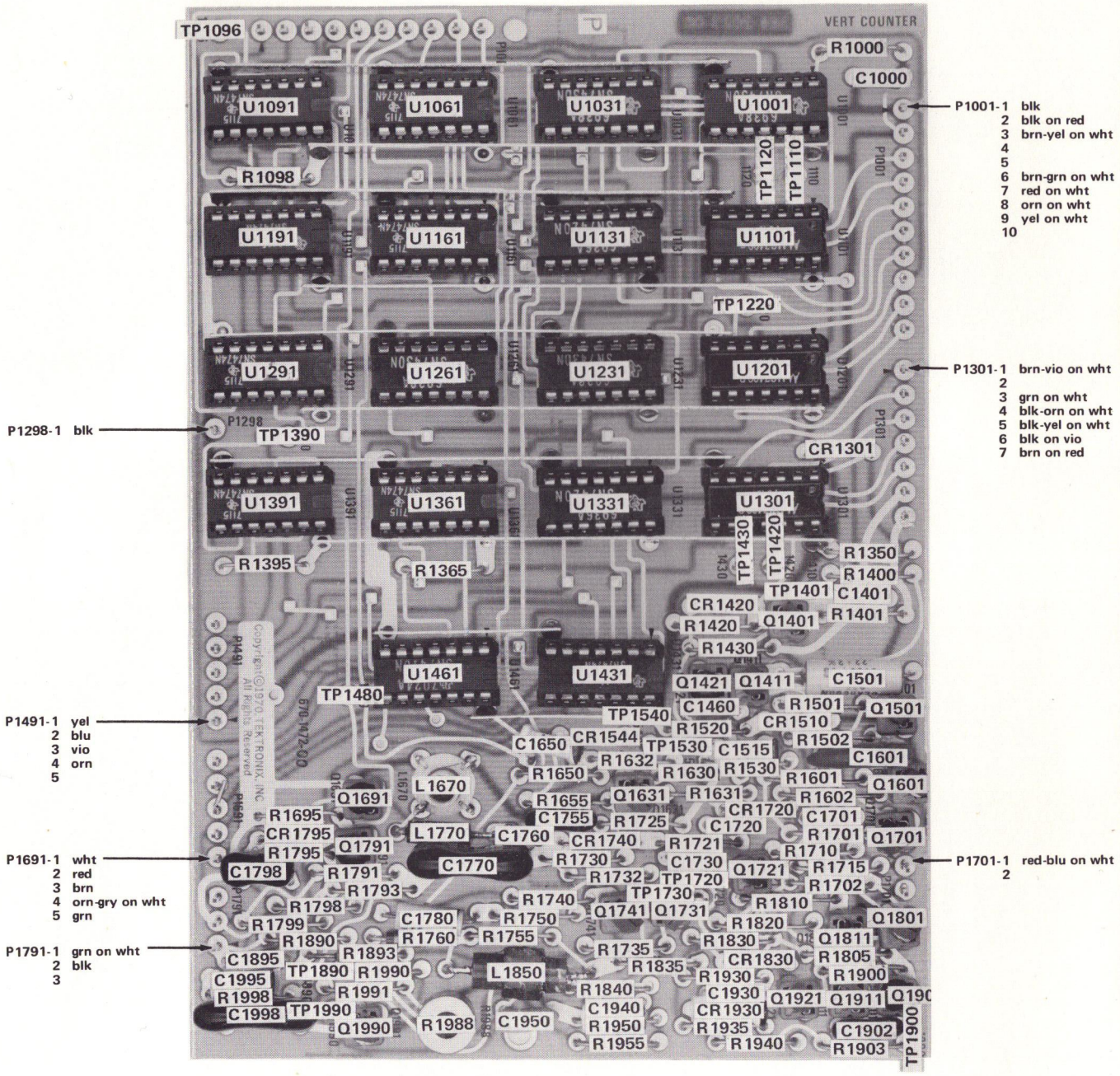








Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view the vertical equalizing and serration pulses; waveform 7, set to view field 2; and waveform 11, internally triggered (+).



A1 VERT COUNTER Circuit Board Assembly

WAVEFORMS

P1298

A1 VERTICAL COUNTER CIRCUIT BOARD

500KHz 250KHz 125KHz 62.5KHz 31.25KHz 15.625KHz 15.625KHz

P/O P1691 P/O P1791

HORIZONTAL INTEGRATOR

PHASE DETECTOR

1MHz OSCILLATOR

+64 COUNTER

VIT H BLANKING

DELAY

FIELD RECOGNITION

MATRIX

VERTICAL INTEGRATOR

÷ 525 COUNTER

CLOCK

NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. ALL UNUSED IC PINS ARE GROUNDED.
3. ALL IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.

P1701 COMPOSITE SYNC P5294-4

INSERT DELAY

SYNC DELAY

TIME 31

TIME 15

P4390-6

P2400-1

VIT H BLANKING P4960-1

P9832

P9852

VERT RESET P4590-1

FIELD 2 P4100-3

FIELD 1 P4100-2

P1301

9 LINE KEY OUT P201-3 P201-1

VERT BLANKING P4080-7

FIELD SQ WAVE P3890-5

WINDOW P3890-8

P9802

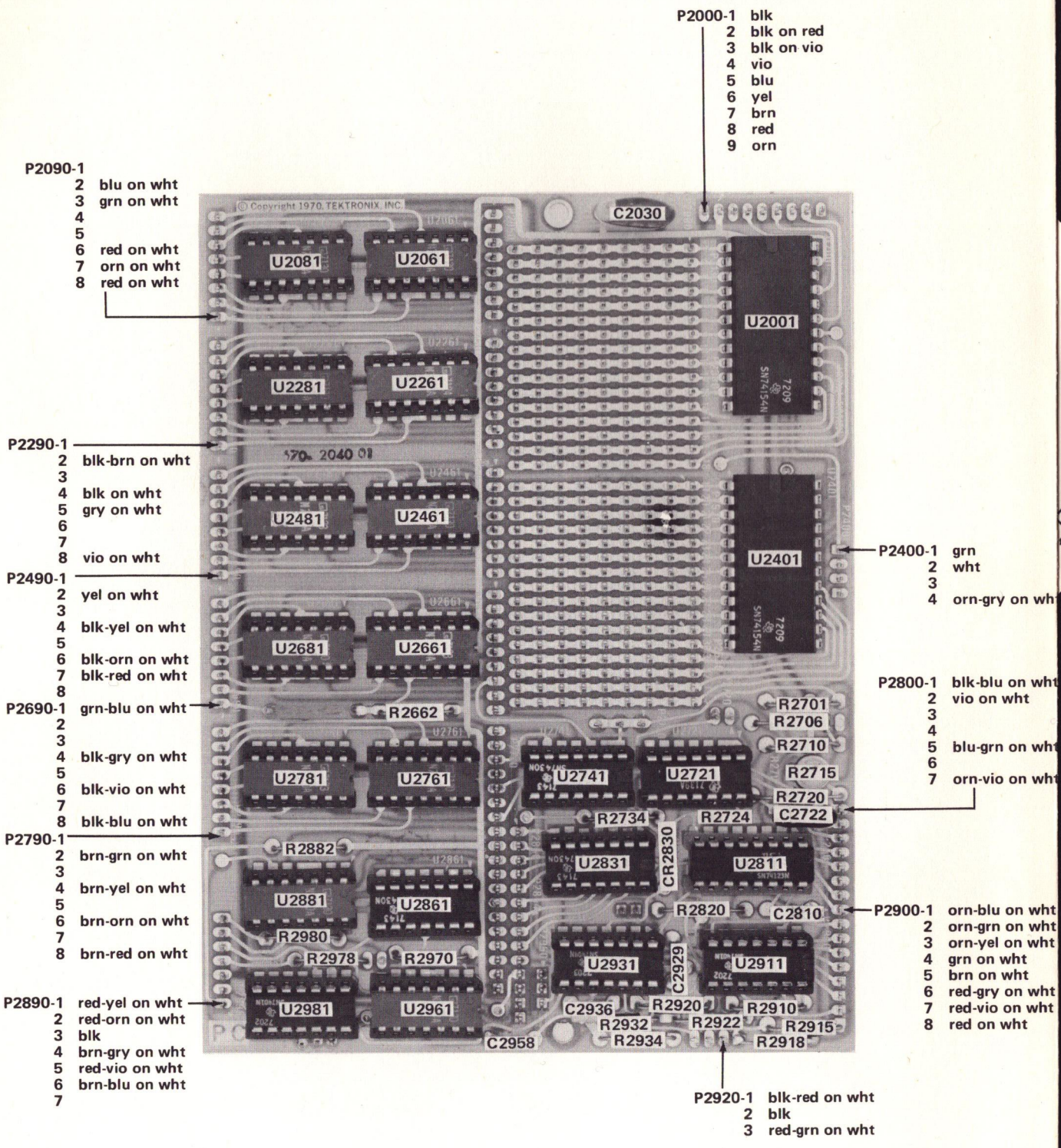
P1001

P1061

DAJ

REV. B, AUG 1974

HORIZONTAL & VERTICAL COUNTERS 1



A2 HORIZ TIMING Circuit Board Assembly

NOTES:
24 PIN IC'S: PIN 24 IS CONNECTED TO +5VOLTS, PIN 12 IS CONNECTED TO GROUND.
ALL OTHER IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 IS CONNECTED TO +5 VOLTS.

P2400
P1691-1 ① — 15.625 KHz

P2000
P1491-4 — 500 KHz
P1691-2 — 15.625KHz
P1691-3 — 31.25 KHz
① P1491-1 — 62.5 KHz
P1491-2 — 125 KHz
P1491-3 — 250 KHz

-15V → P2000 pin 3 → -15V P3080-5 ③a
+5V → P2000 pin 2 → +5V P3060-2
+5V — C2030 100μF

U2001 74154N — inputs A B C D G2 G1 = 23 22 21 20 19 18; outputs 0–15
U2401 74154N — inputs A B C D G2 G1 = 23 22 21 20 19 18; outputs 0–15

COLOR CODE →
INSTANTS OF TIME DURING H INTERVAL → 63.56/32 μs

U2001 outputs → 9-3, 9-4, 9-5, 9-6, 9-7, 9-8, 9-0, 9-01, 9-02, 9-03, 9-04, 9-05, 9-06, 9-07, 9-08, 9-12
U2401 outputs → 9-13, 9-14, 9-15, 9-16, 9-17, 9-18, 9-23, 9-24, 9-25, 9-26, 9-27, 9-28, 9-34, 9-35, 32/0, 9-1, 9-2

P2400
P1691-5 ①
TIME 15
TIME 32/0
TIME 31
P9390-5 ④

P2130: TIME 4 P7003-1 ⑦b; TIME 5 P3200-1 ③a; TIME 8 P458-5 ⑨b; TIME 9 P3200-2 ③a; TIME 11 P420-1 ⑨b; TIME 12 P498-2 ⑨b
P2330: TIME 14 P201-6 ⑨a; TIME 15 P3200-4 ③a; TIME 16 P201-7 ⑨a; TIME 18 P498-1 ⑨b
P2530: TIME 21 P3200-6 ③a; TIME 24 3200-7 ③a; TIME 24 P401-3 ⑨b
P2630: TIME 27 3200-8 ③a; TIME 30 P201-5 ⑨a; TIME 32/0 P201-8 ⑨a; TIME 1 P4590-9 ④

DECODER

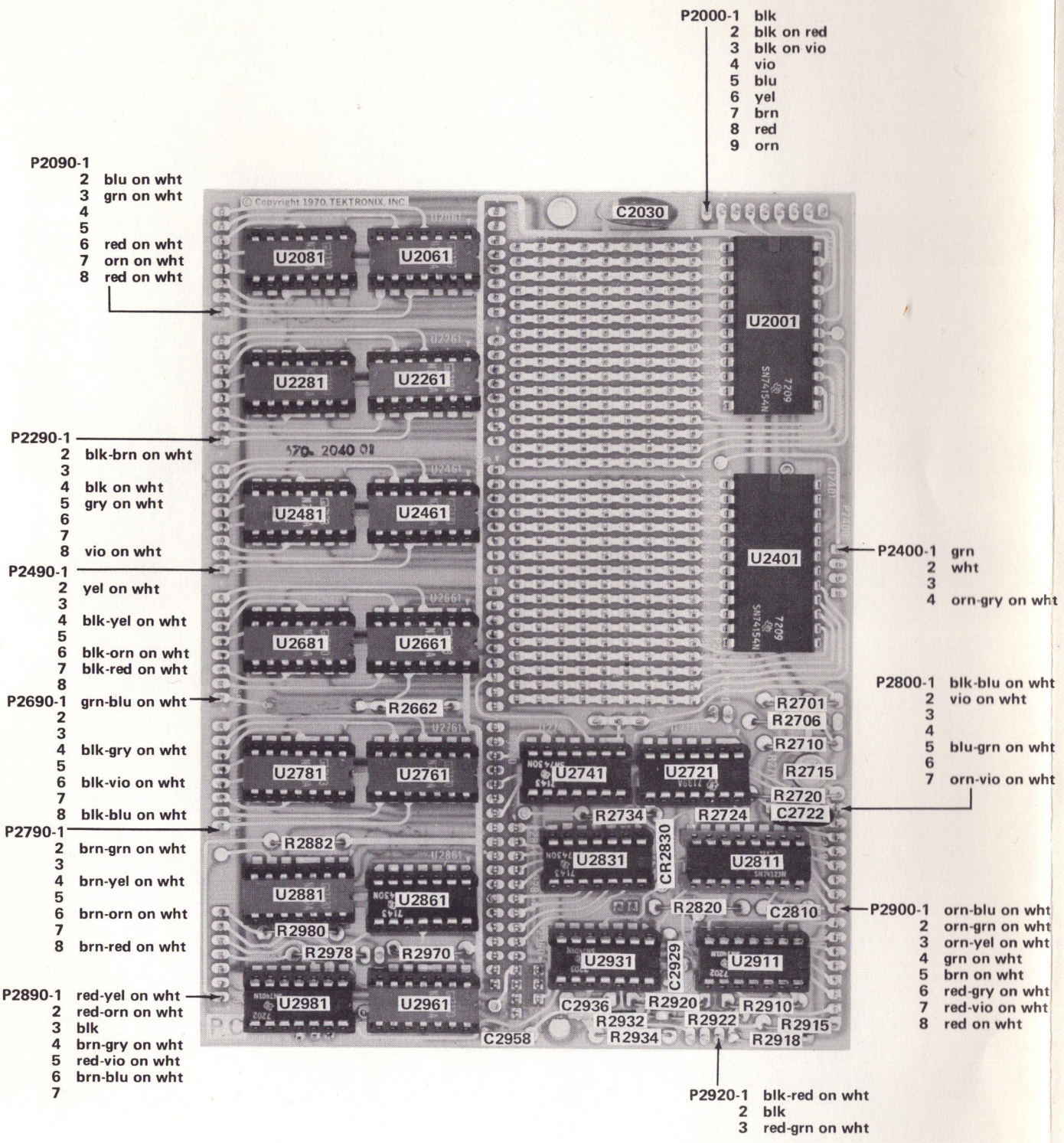
H INTERVAL → 5
TIME INSTANTS CONNECTOR → 4
CODE P2050

MOD PED 20 IRE — P401-1 ⑨b
H BLANKING — 5, 31
VIRS SUB TIMING — 6, 17
BAR TIMING — 12, 25
RAMP TIMING — 8, 28
12.5T PULSE & MOD TIMING — 6, 8
VIRS 70 IRE — 6, 18
VIRS 50 IRE — 6, 24
MB 100 IRE — 5, 8
COMPOSITE BAR — 22, 31
VIRS 7.5 IRE — 6, 30
MB 55 IRE — 8, 31

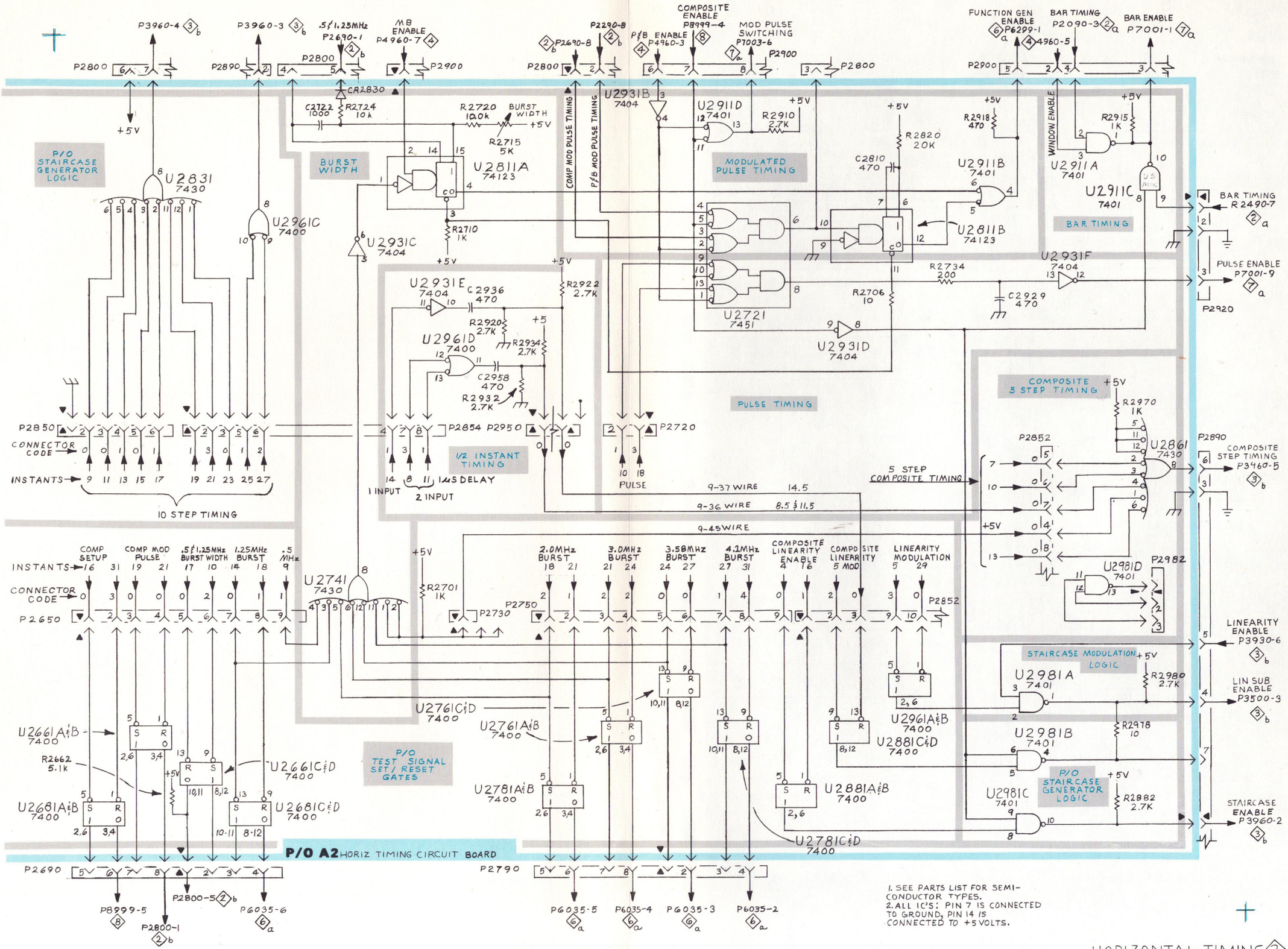
P/O TEST SIGNAL SET/RESET GATES

U2081 A&B 4700N — 2,6 3,4
U2061 A&B 4700N — 2,6 3,4
U2061 C&D 4700N — 10,11 8,12
U2081 C&D 4700N — 10,11 8,12
U2281 A&B 7400N — 2,6 3,4
U2261 A&B 7400N — 2,6 3,4
U2261 C&D 7400N — 10,11 8,12
U2281 C&D 7400N — 10,11 8,12
U2481 A&B 7400N — 2,6 3,4
U2461 A&B 7400N — 2,6 3,4
U2461 C&D 7400N — 10,11 8,12
U2481 C&D 7400N — 10,11 8,12

P2090: P498-6 ⑨b; P3930-2 ③b; P6904-6 ⑥b; P8900-2 ⑧b; P2900-2 ②b
P2290: P3930-10 ③b; P2800-2 ②b; P401-5 ⑨b; P458-4 ⑨b
P2490: P6904-4 ⑥b; P2920-1 ②b; P458-2 ⑨b; P6904-5 ⑥b



A2 HORIZ TIMING Circuit Board Assembly



1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. ALL IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 IS CONNECTED TO +5 VOLTS.

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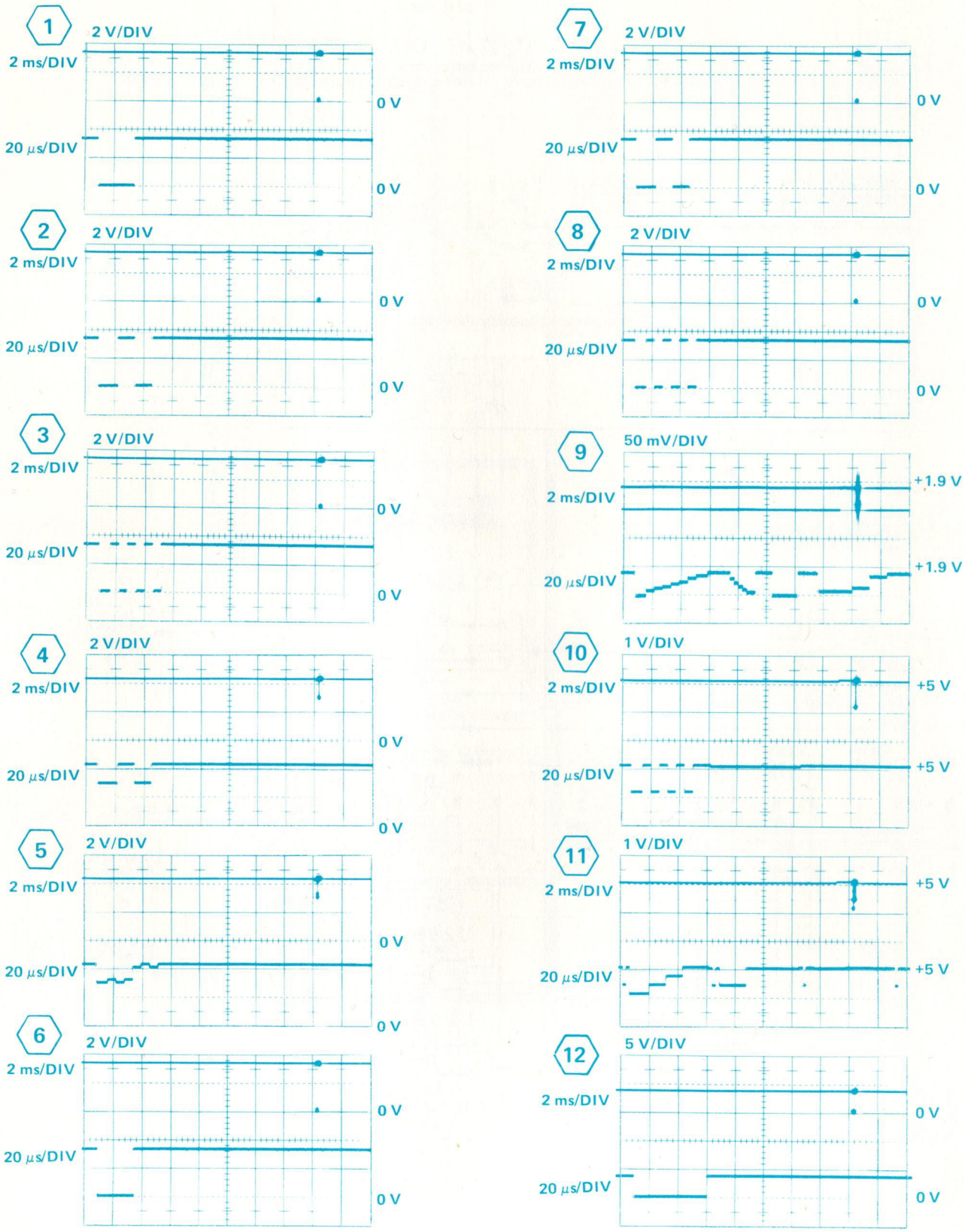
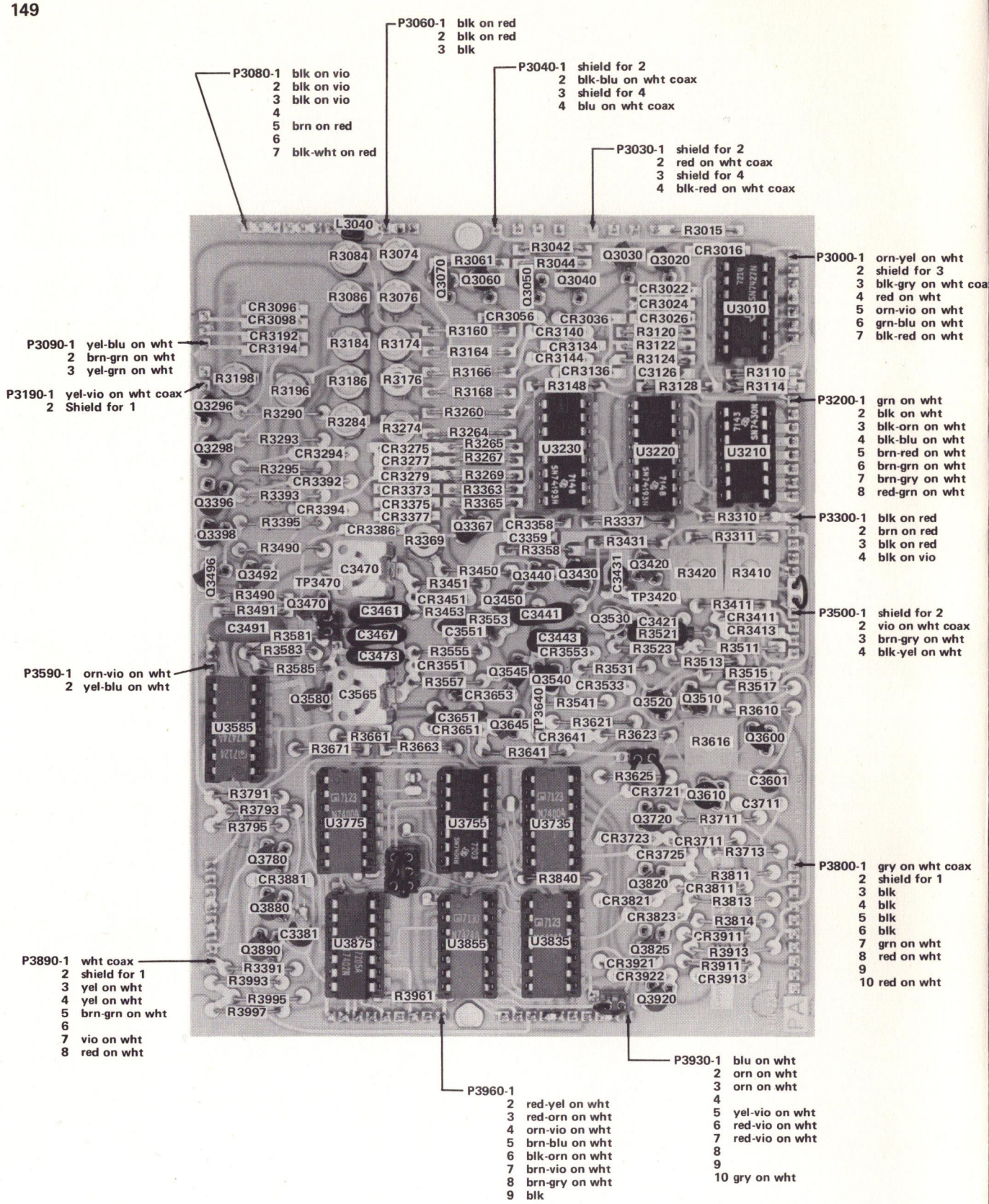
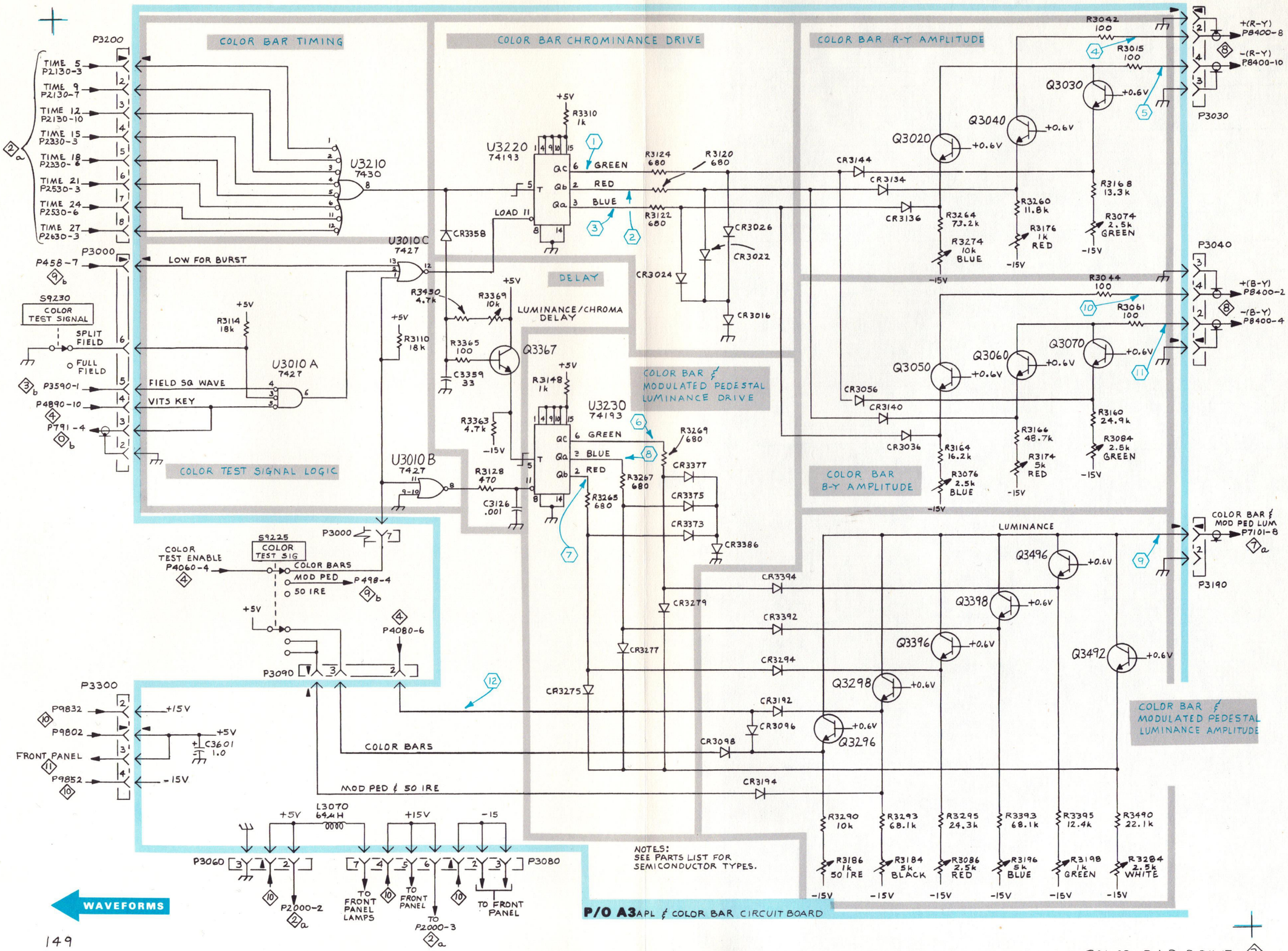
HORIZONTAL TIMING 2b
M.E.B

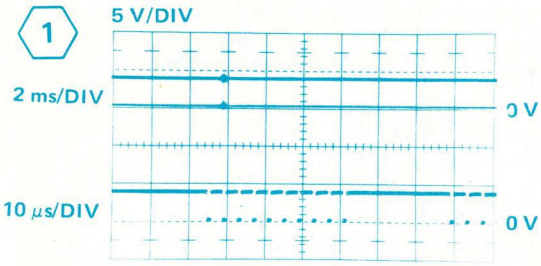


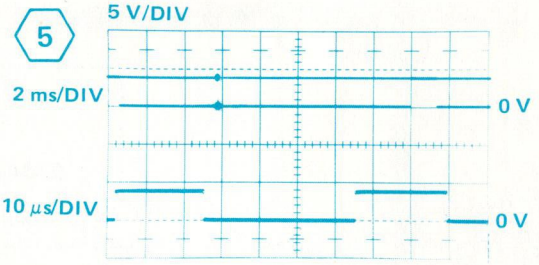
Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view lines 18, 19, and 20 of field 2.

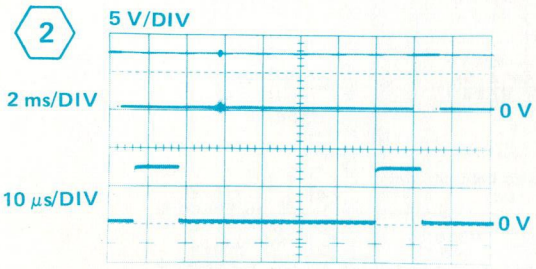


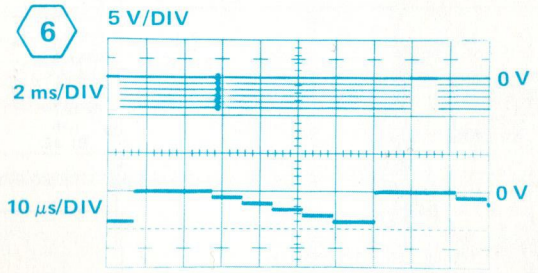
A3 APL STAIRCASE & COLOR BAR Circuit Board Assembly

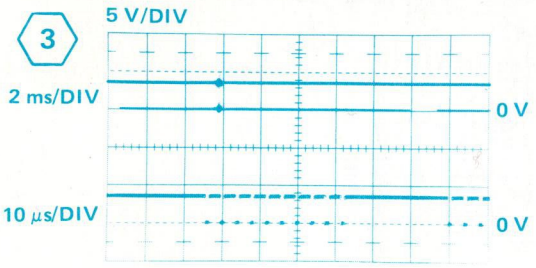

COLOR BAR TIMING
COLOR BAR CHROMINANCE DRIVE
COLOR BAR R-Y AMPLITUDE
COLOR BAR B-Y AMPLITUDE
COLOR TEST SIGNAL LOGIC
DELAY
COLOR BAR & MODULATED PEDESTAL LUMINANCE DRIVE
COLOR BAR & MODULATED PEDESTAL LUMINANCE AMPLITUDE
P3200
TIME 5 P2130-3
TIME 9 P2130-7
TIME 12 P2130-10
TIME 15 P2330-3
TIME 18 P2330-6
TIME 21 P2530-3
TIME 24 P2530-6
TIME 27 P2630-3
U3210 7430
U3220 74193
U3230 74193
U3010A 7427
U3010B 7427
U3010C 7427
P3000
P458-7
LOW FOR BURST
S9230 COLOR TEST SIGNAL
SPLIT FIELD
FULL FIELD
P3590-1
P4890-10
P791-4
FIELD SQ WAVE
VITS KEY
R3114 18k
R3110 18k
R3450 4.7k
R3369 10k
LUMINANCE/CHROMA DELAY
R3365 100
C3359 33
Q3367
R3148 1k
R3363 4.7k
R3128 470
C3126 .001
R3310 1k
R3124 680
R3120 680
R3122 680
LOAD 11
CR3358
GREEN
RED
BLUE
R3269 680
R3267 680
R3265 680
CR3377
CR3375
CR3373
CR3386
CR3026
CR3022
CR3024
CR3016
CR3144
CR3134
CR3136
CR3056
CR3140
CR3036
R3042 100
R3015 100
R3044 100
R3061 100
Q3030
Q3040
Q3020
Q3070
Q3060
Q3050
+0.6V
R3264 73.2k
R3274 10k BLUE
R3260 11.8k
R3176 1k RED
R3168 13.3k
R3074 2.5k GREEN
R3164 16.2k
R3076 2.5k BLUE
R3166 48.7k
R3174 5k RED
R3160 24.9k
R3084 2.5k GREEN
-15V
P3030
P3040
+(R-Y) P8400-8
-(R-Y) P8400-10
+(B-Y) P8400-2
-(B-Y) P8400-4
COLOR TEST ENABLE P4060-4
S9225 COLOR TEST SIG
COLOR BARS
MOD PED
50 IRE
P498-4
P3000
P4080-6
P3090
P3300
P9832
P9802
FRONT PANEL
P9852
+15V
C3601 1.0
COLOR BARS
MOD PED & 50 IRE
L3070 64μH
P3060
P3080
P2000-2
P2000-3
TO FRONT PANEL LAMPS
TO FRONT PANEL
LUMINANCE
Q3496
Q3398
Q3396
Q3492
Q3298
Q3296
CR3394
CR3279
CR3392
CR3277
CR3294
CR3275
CR3192
CR3096
CR3098
CR3194
R3290 10k
R3293 68.1k
R3295 24.3k
R3393 68.1k
R3395 12.4k
R3490 22.1k
R3186 1k 50 IRE
R3184 5k BLACK
R3086 2.5k RED
R3196 5k BLUE
R3198 1k GREEN
R3284 2.5k WHITE
P3190
COLOR BAR & MOD PED LUM P7101-8
NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
P/O A3 APL & COLOR BAR CIRCUIT BOARD
WAVEFORMS
149
REV. B, AUG 1974
COLOR BAR DRIVE 3a
DAJ
COLOR BAR DRIVE
3a

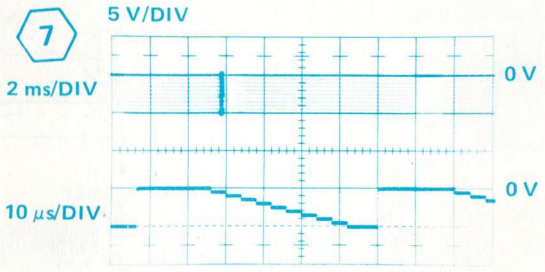


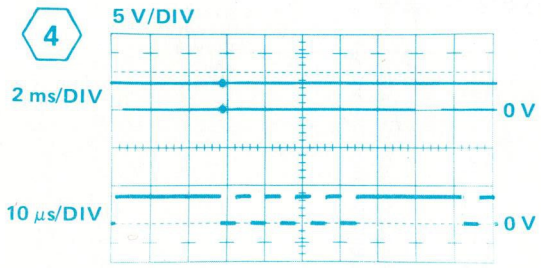


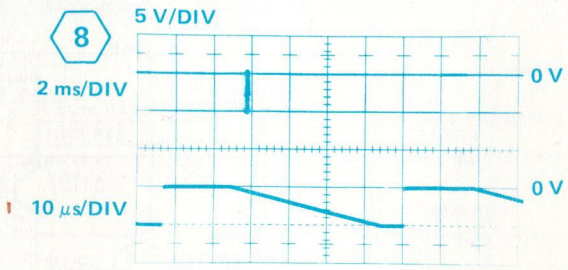






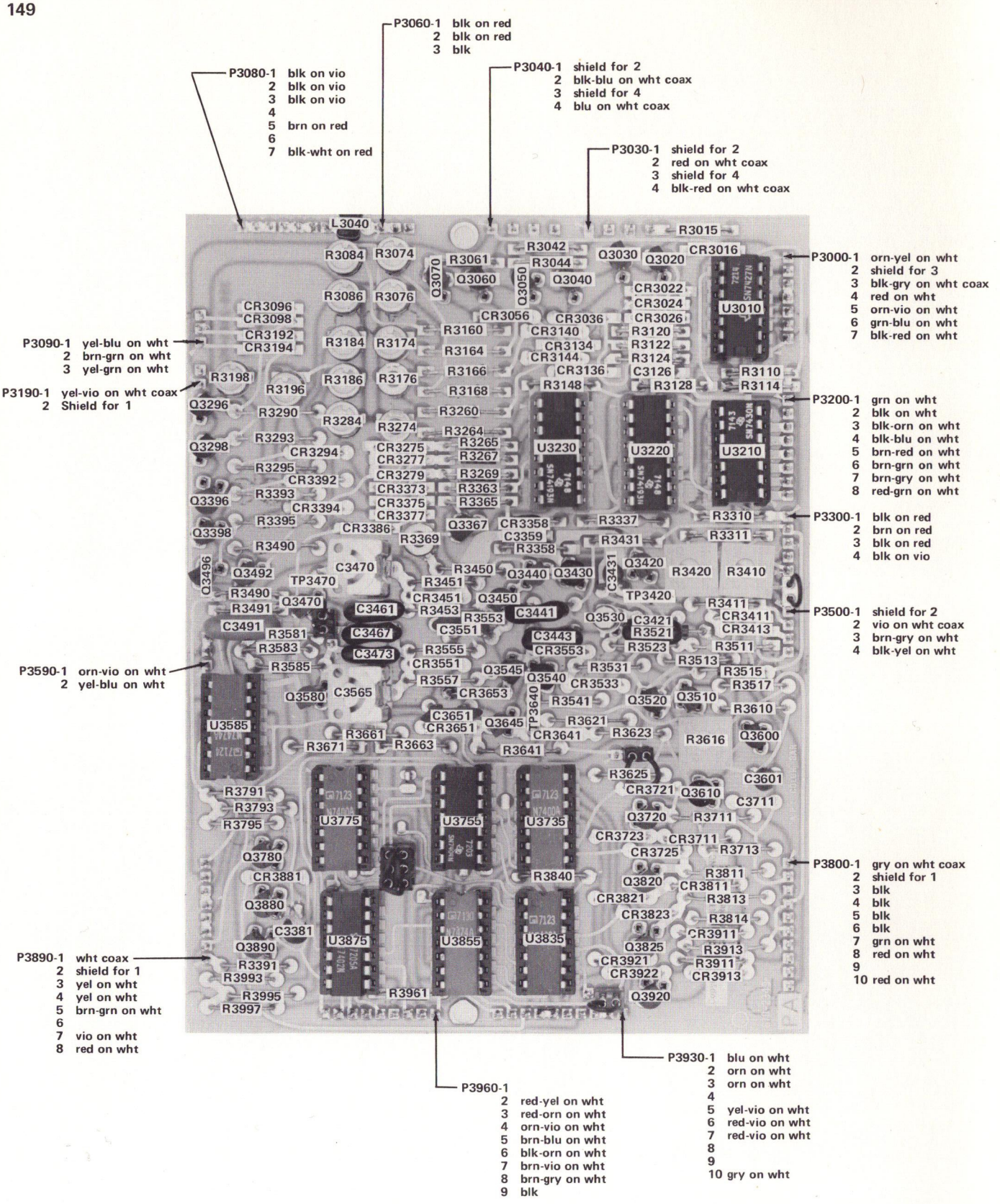






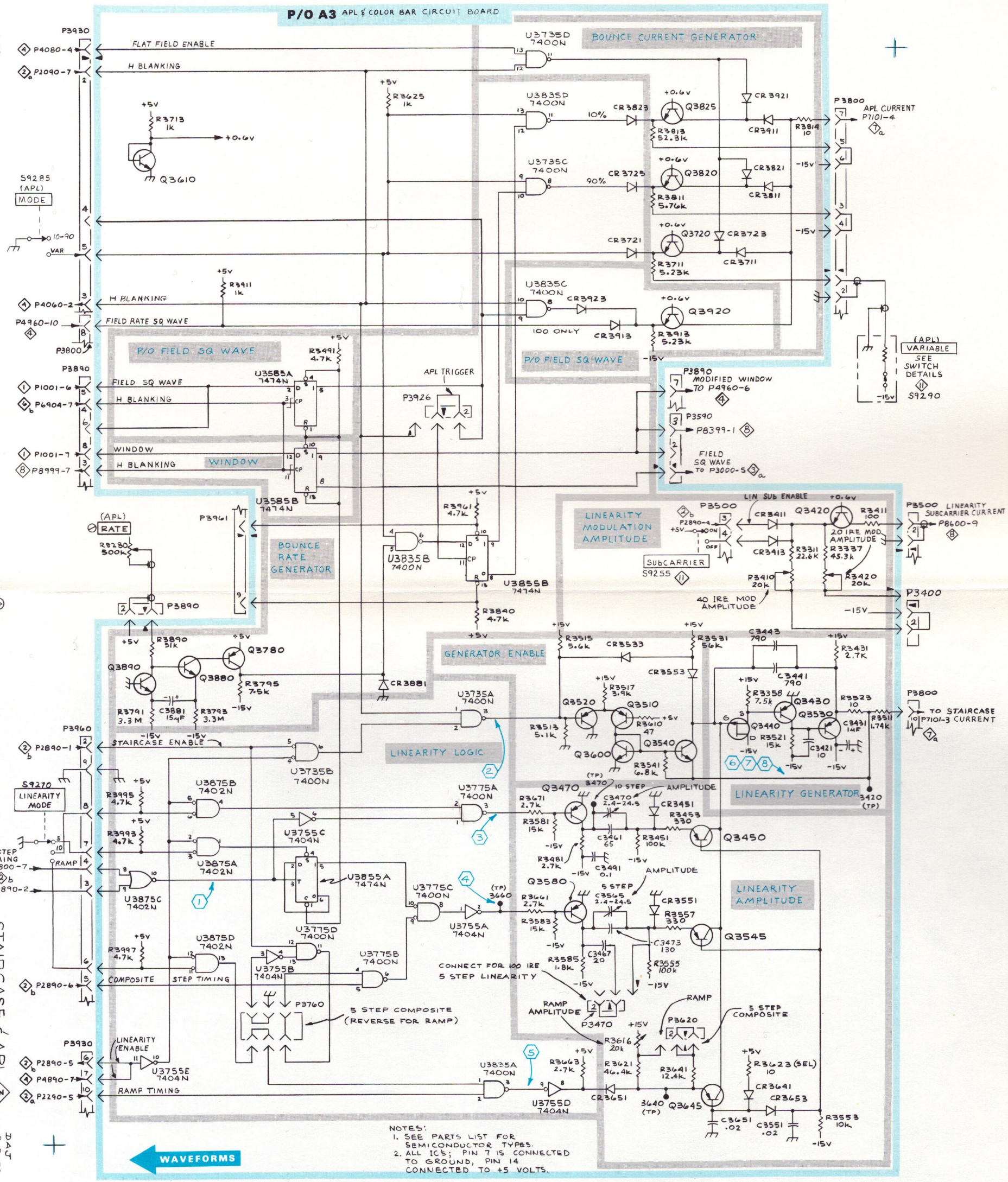
Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field and the FULL FIELD SIG Mode switch set to LINEARITY; waveform 3 , LINEARITY Mode switch set to 10 STEP; waveform 5 , LINEARITY Mode switch set to RAMP; waveform 7 , LINEARITY Mode switch set to 10 STEP; and waveform 8 , LINEARITY Mode switch set to RAMP.

Ⓐ



A3 APL STAIRCASE & COLOR BAR Circuit Board Assembly

P/O A3 APL & COLOR BAR CIRCUIT BOARD

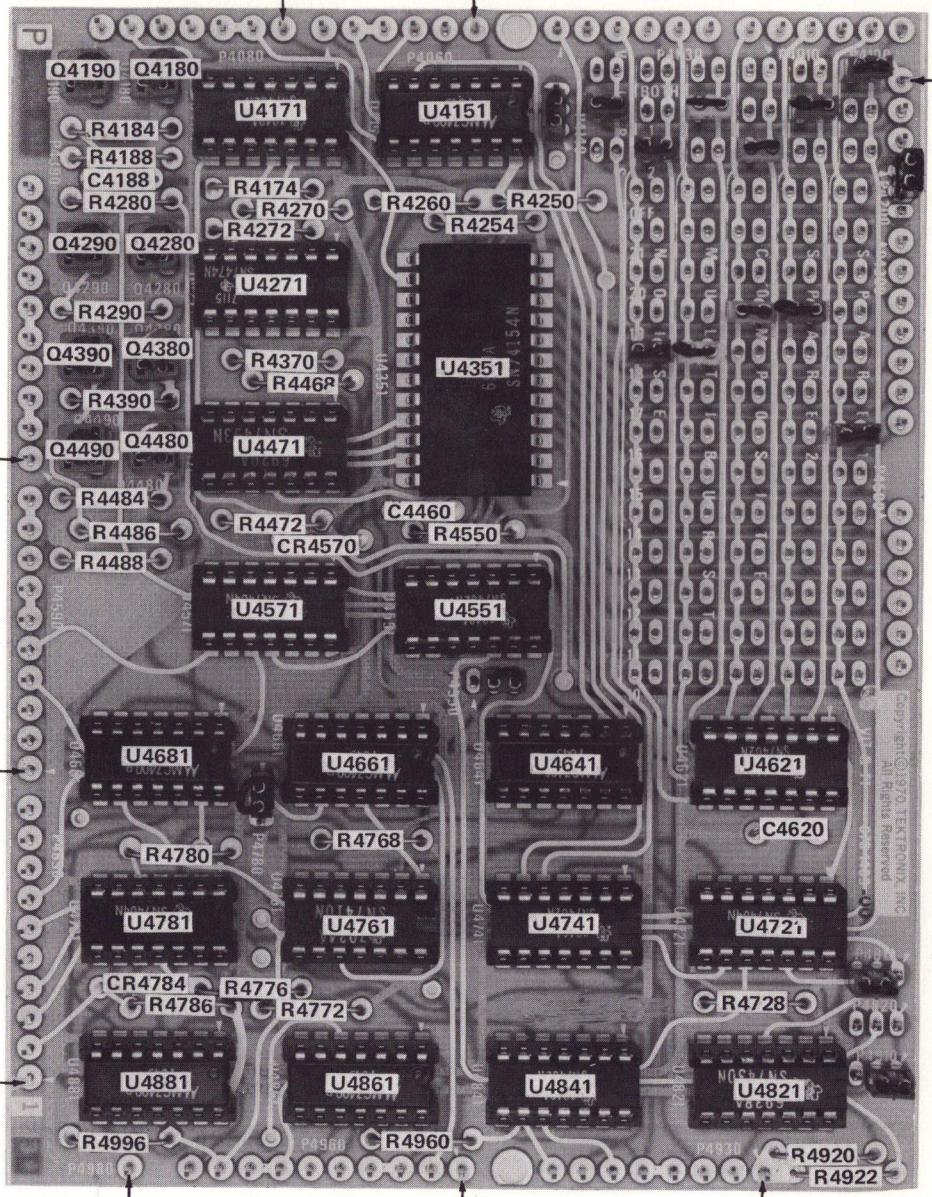


NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. ALL ICS; PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.

WAVEFORMS

STAIRCASE & APL ◇3b

DAJ 8-9-72



A4 VIT FULL FIELD Circuit Board Assembly

Ⓐ

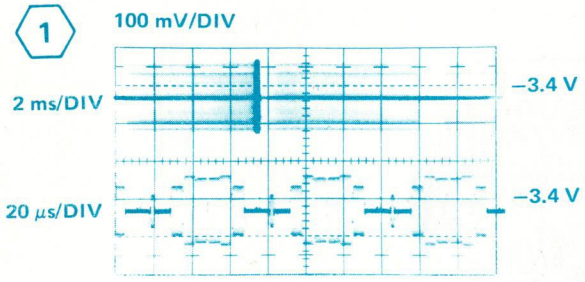
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. U4471: PIN 10 IS CONNECTED TO GROUND, PIN 5 CONNECTED TO +5 VOLTS.
3. U4351: PIN 24 IS CONNECTED TO +5 VOLTS, PIN 5 CONNECTED TO GROUND.
4. ALL OTHER IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.

VIT SPARE
VIT AUX
VIT "OR"
P/O VIRS LOGIC
P/O COLOR TEST
FIELD & LINE MATRIX
* FOR AUXILIARY LINE/FIELD PROGRAMER
SPARE 1
SPARE 2
COMPOSITE
MULTIBURST
COLOR TEST SIG
VIRS
P/O VIRS DETECTOR (SEE 9b)
9 LINE KEYOUT
4 LINE TO 16 LINE DECODER
MODIFIED VERTICAL BLANKING
SYNC RESET
FIELD SQ WAVE
FLAT FIELD
WINDOW
SIN²
MULTIBURST
LINEARITY
H BLANKING
MODIFIED WINDOW
RELAY MODE
BURST UNLOCK
PREVIEW PROGRAM LAMP INDICATOR
P/O VIRS LOGIC
MODE DETECTOR
A4 FULL FIELD & VITS CIRCUIT BOARD
FROM FULL FIELD MODE SWITCH, S9210
REMOTE J9014

VIT & FULL FIELD LOGIC 4
DAJ

REV. B, AUG 1974

1



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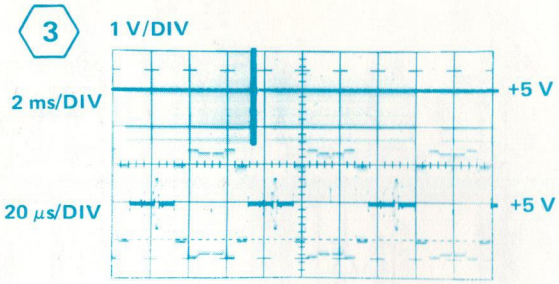

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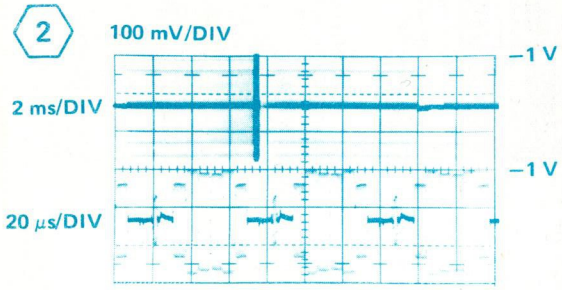

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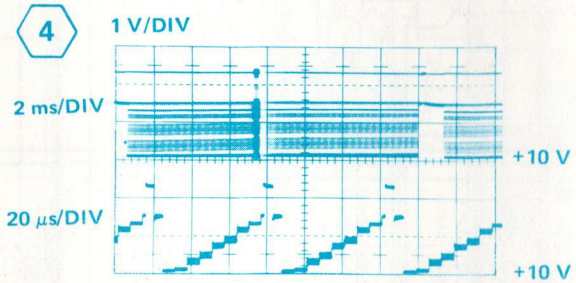

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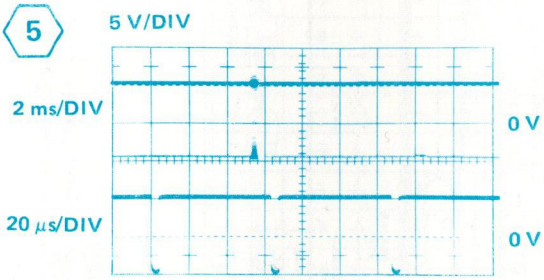
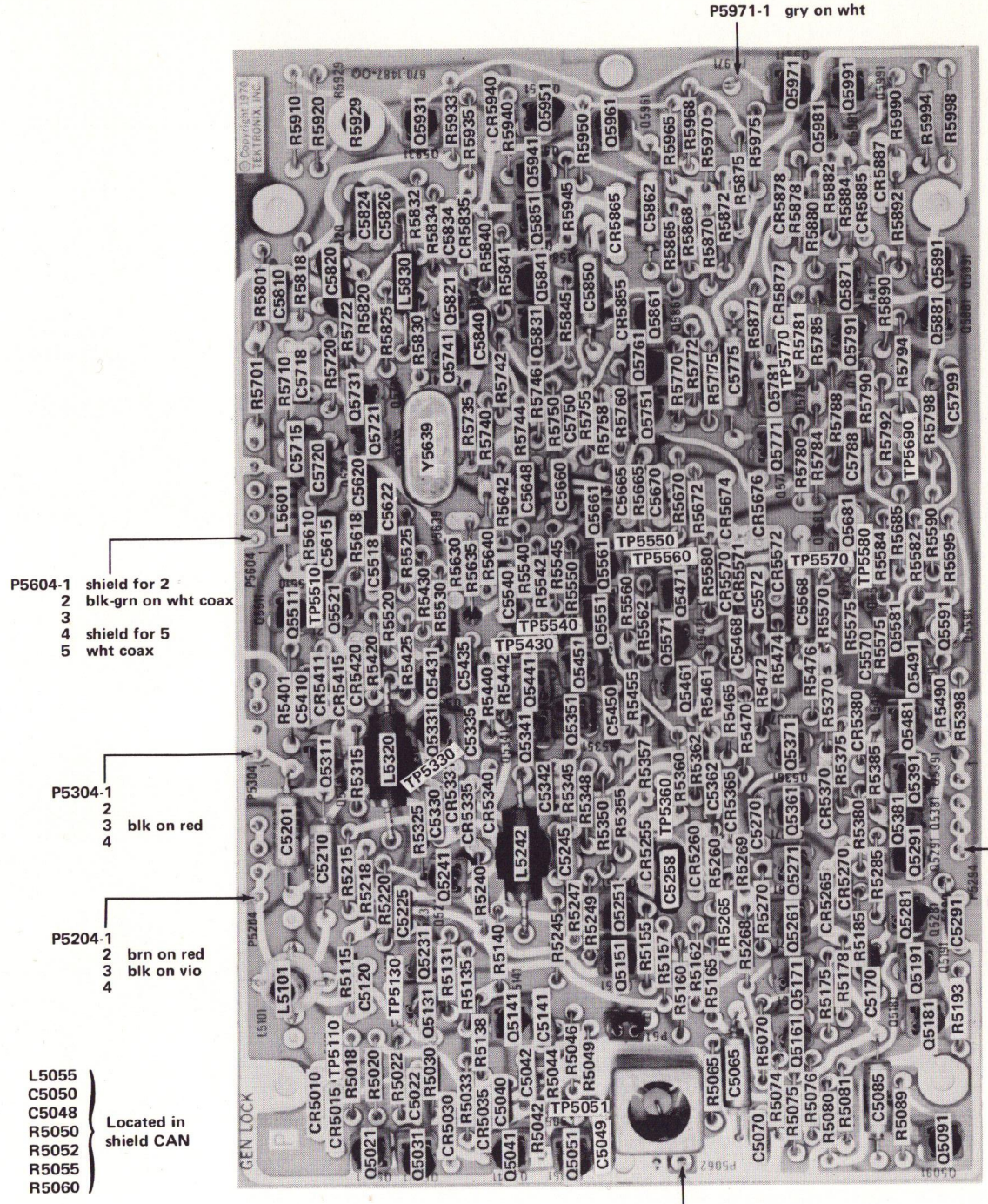
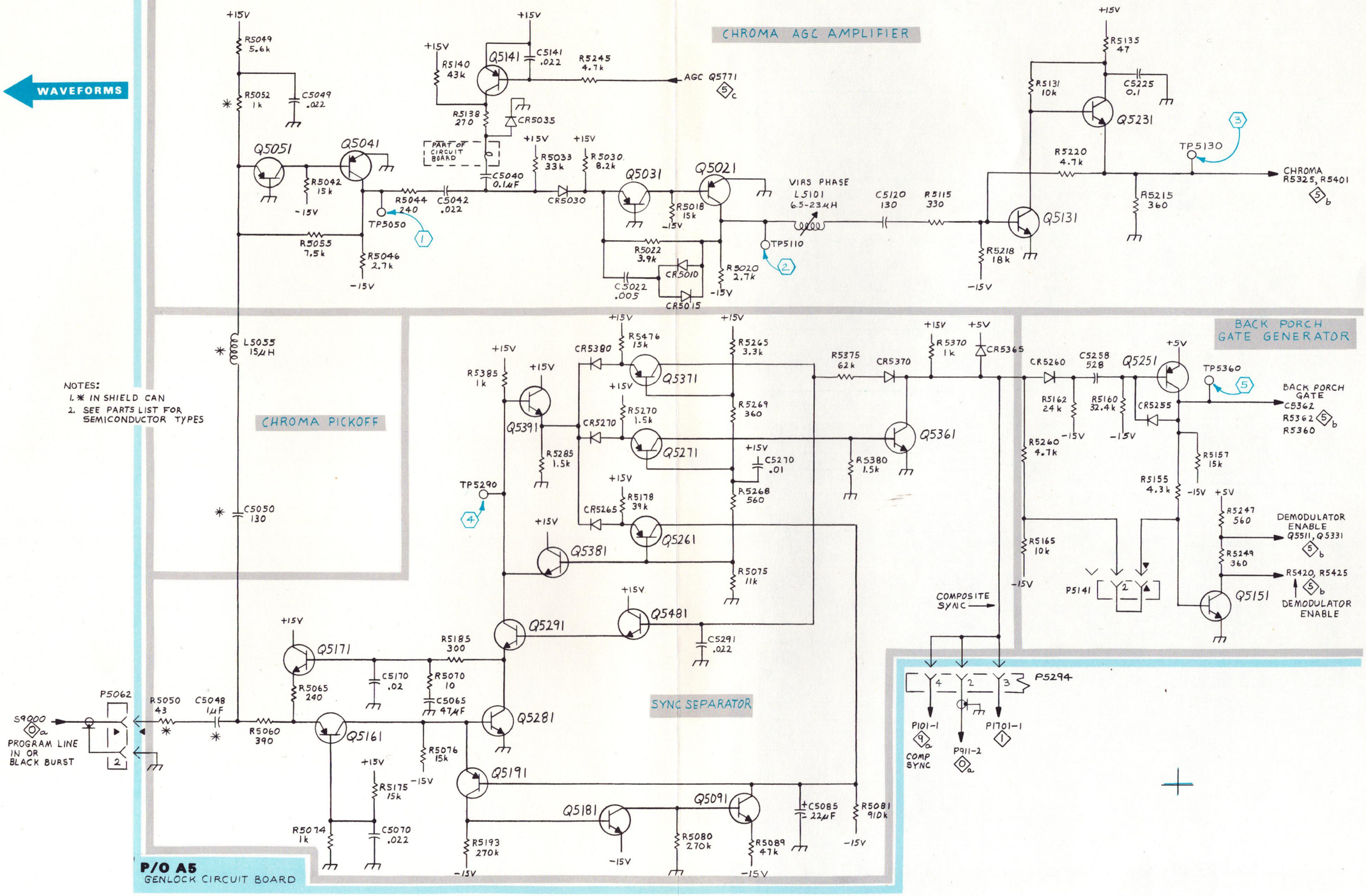


Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field.



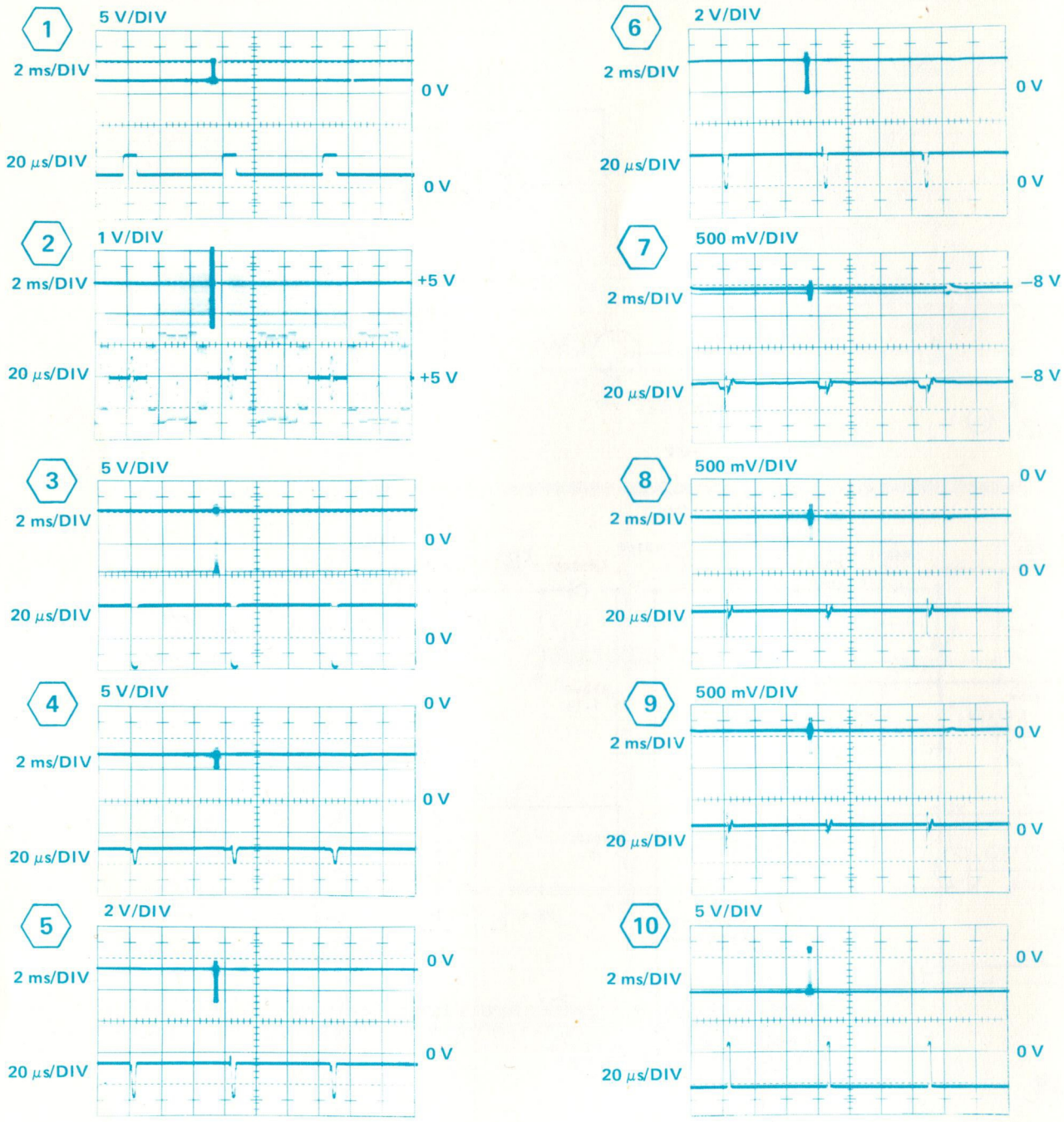
A5 GENLOCK Circuit Board Assembly



REV. B, AUG 1974

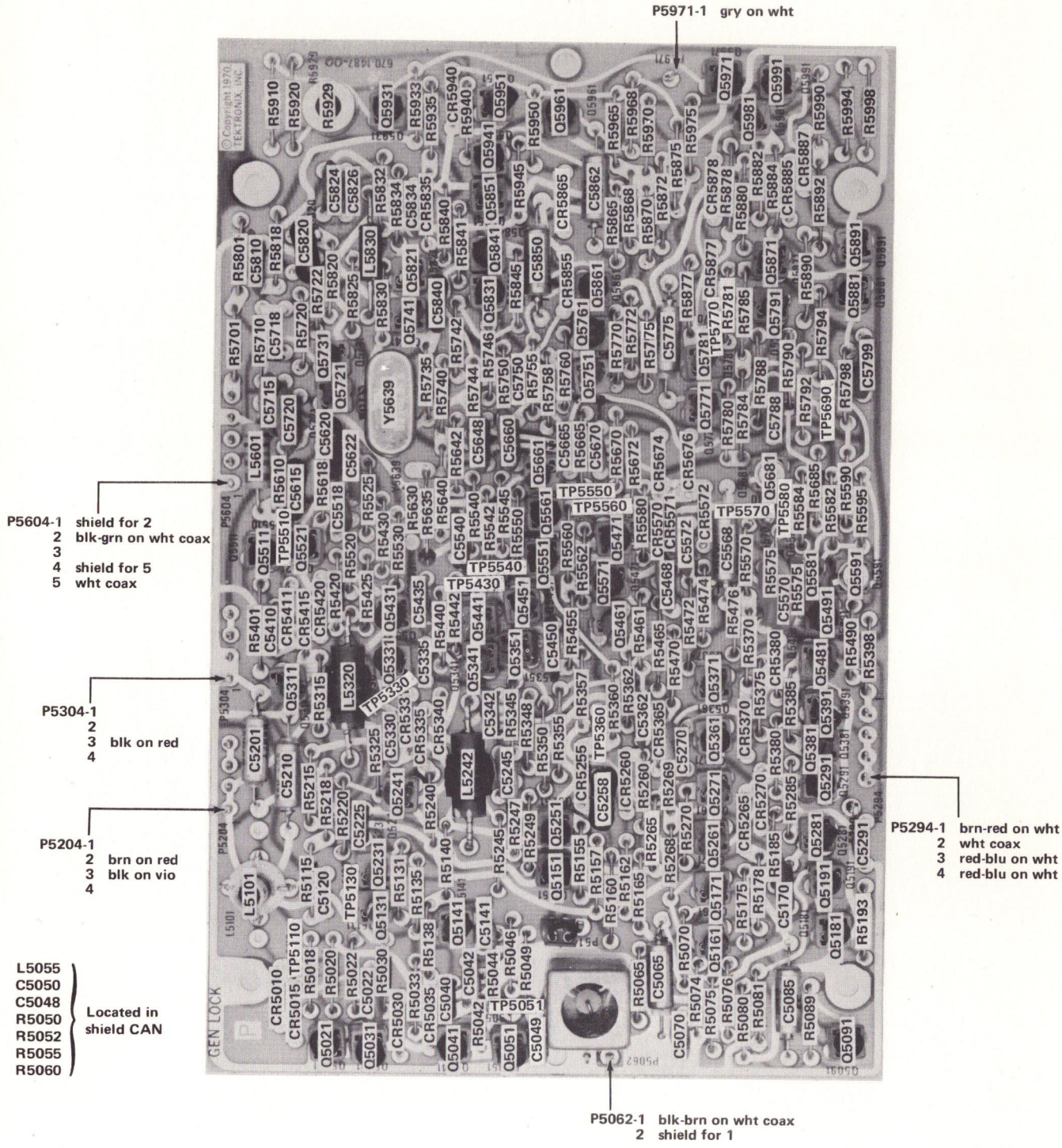
SYNC STRIP & CHROMA AGC AMP 5a

DAJ

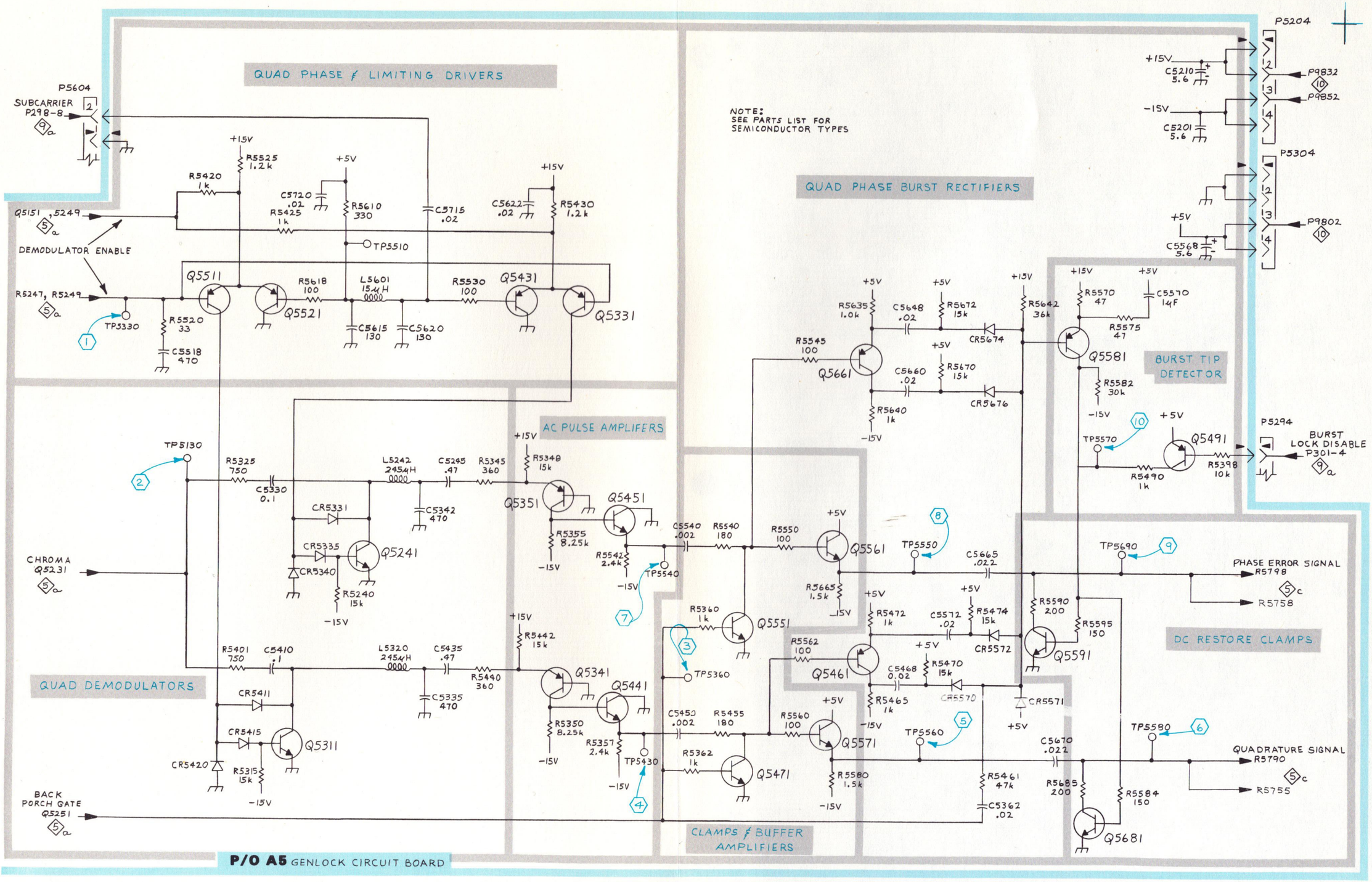


Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field.

Ⓐ

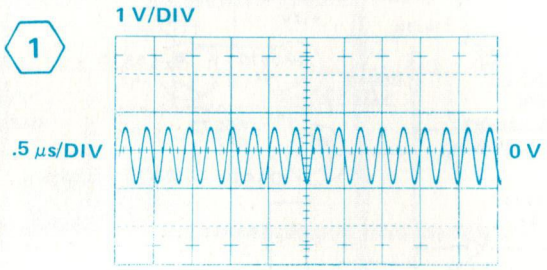


A5 GENLOCK Circuit Board Assembly

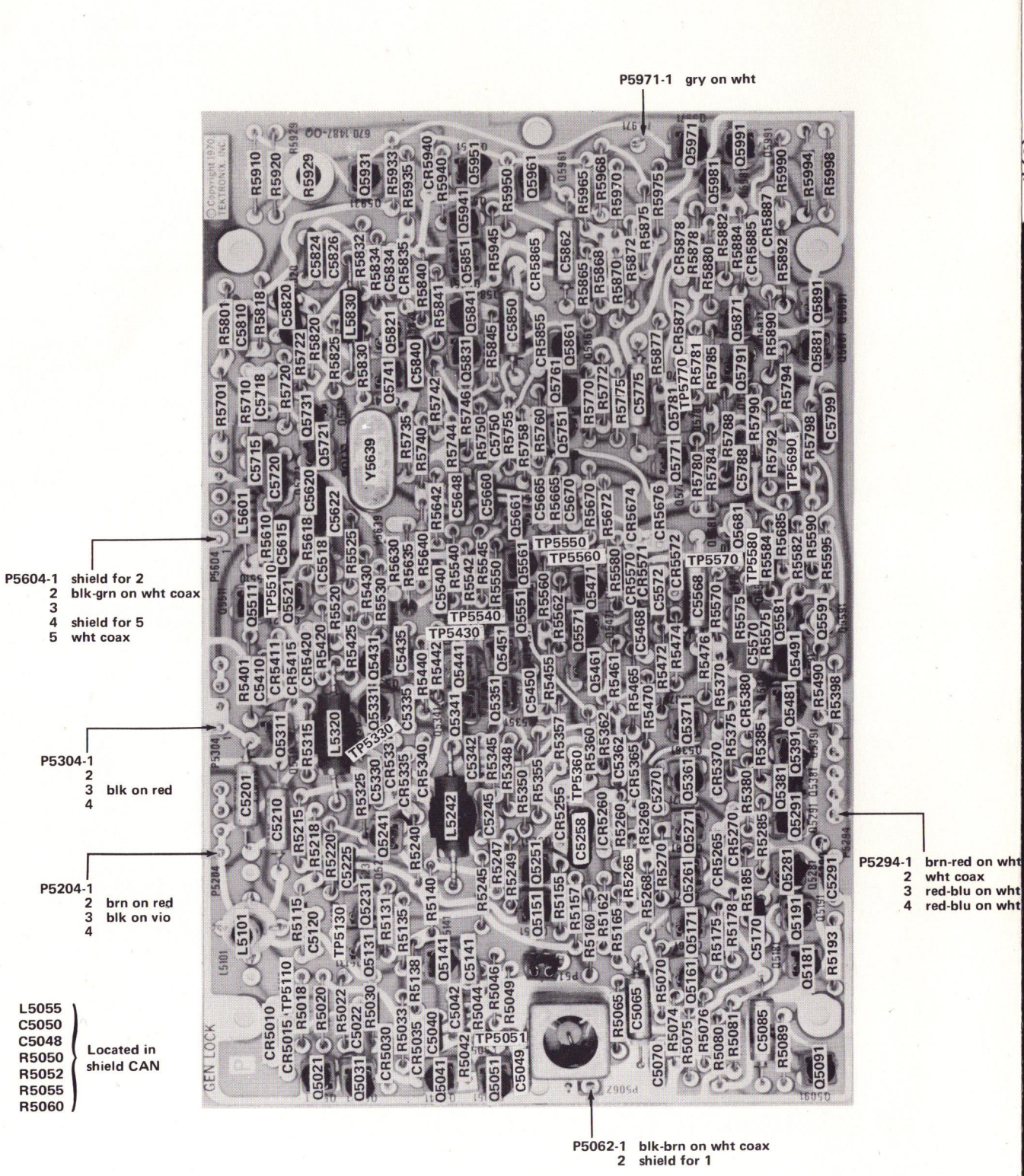


P/O A5 GENLOCK CIRCUIT BOARD

WAVEFORMS



Waveforms and Voltages obtained under conditions given on the Diagram Title page except: Waveform obtained using internal triggering (+).



A5 GENLOCK Circuit Board Assembly

Ⓐ

NOTES:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

DC RECTIFIER & PEAK DETECTOR

AGC COMPARATOR

SUBCARRIER OSCILLATOR

SUBCARRIER AMPLIFIER

QUAD LOCK DETECTOR

BURST PRESENT DETECTOR

SUBCARRIER REFERENCE SWITCH

ERROR AMPLIFIER

BAND SWITCH

QUADRATURE SIGNAL C5670 5b

PHASE ERROR SIGNAL C5665 5b

TO AGC R5245 5a

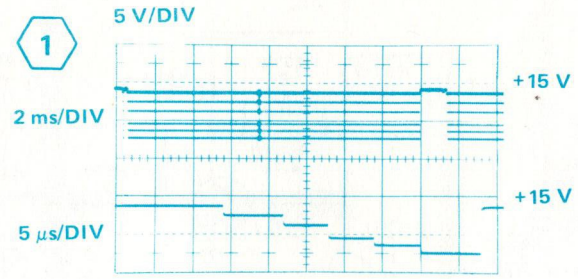
SUBCARRIER P60-3 9a

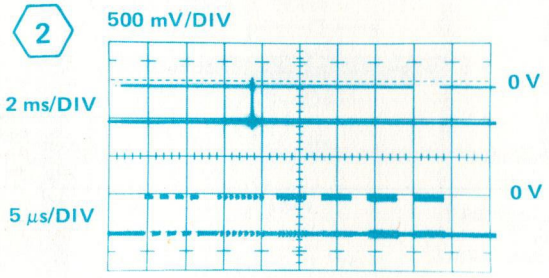
BURST UNLOCK P298-6 9a

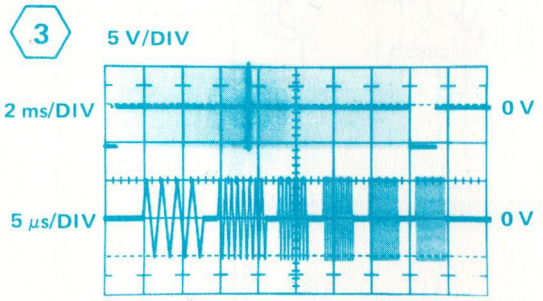
P5604

P5971

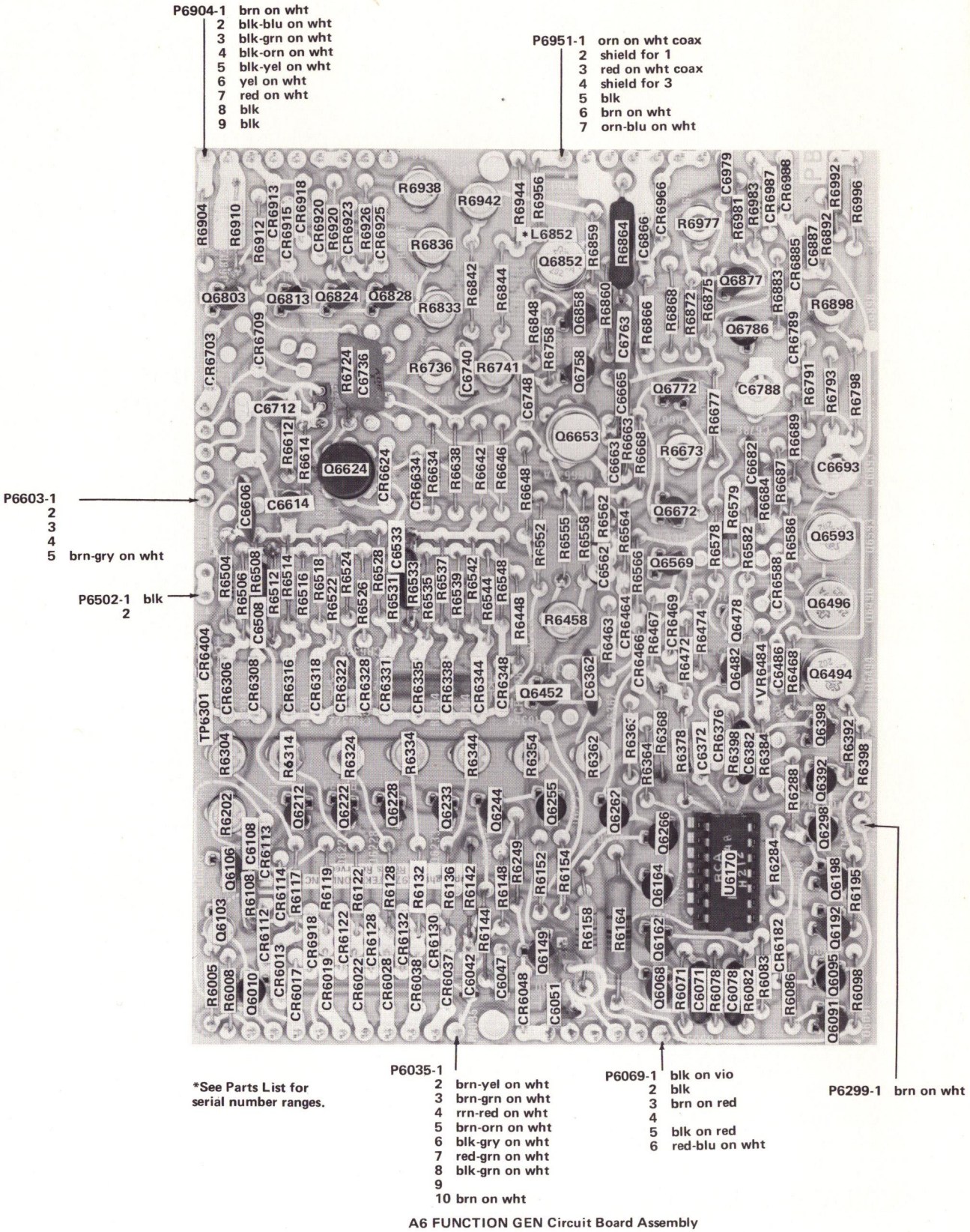
3.58MHz ADJ.







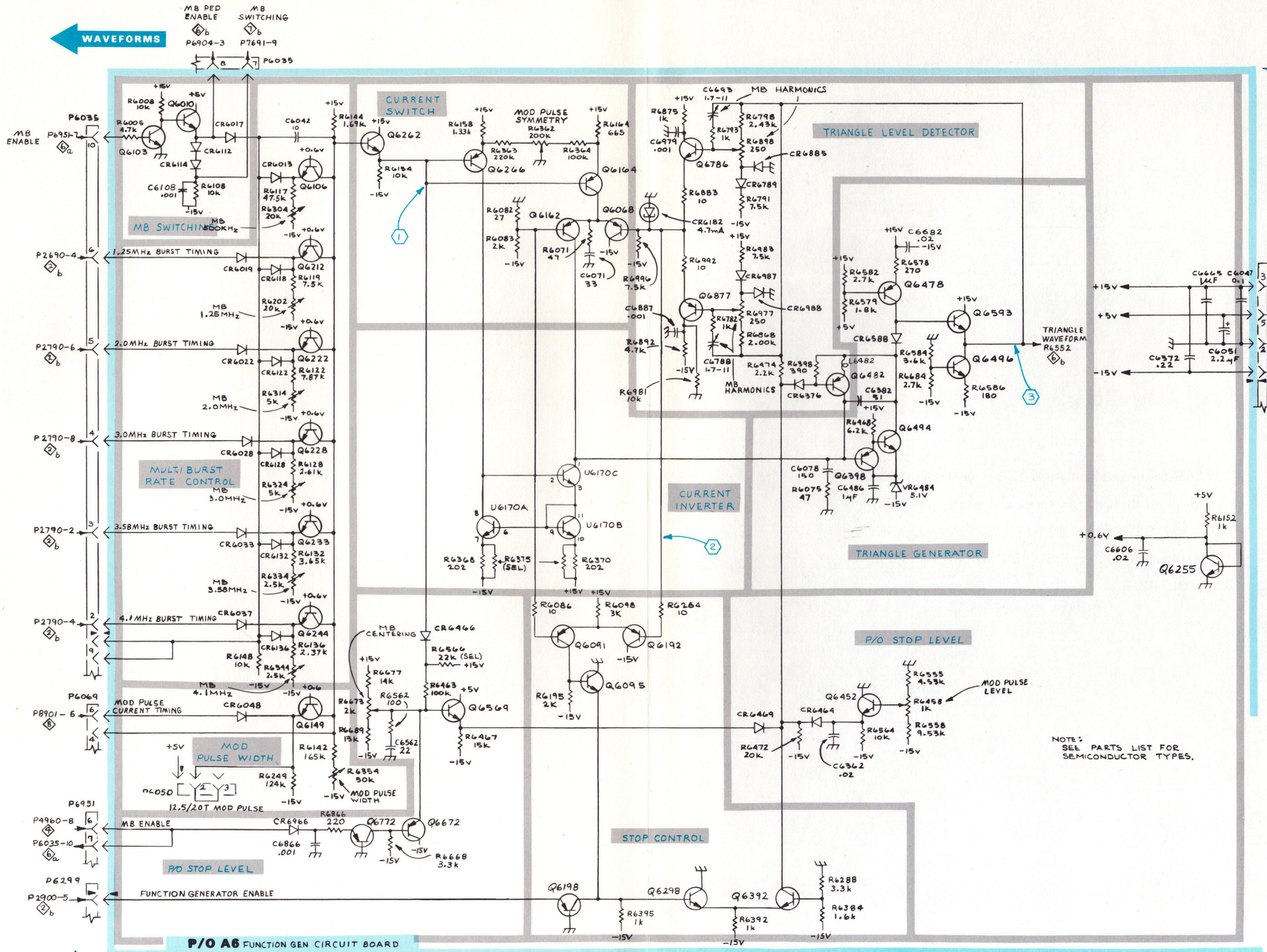
Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field and the FULL FIELD SIG Mode switch set to MULTIBURST.



*See Parts List for serial number ranges.

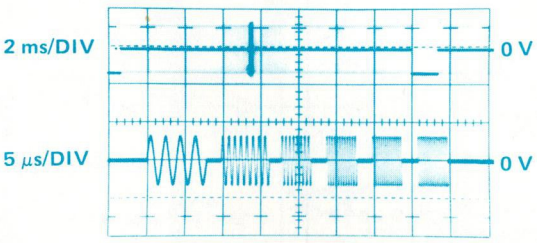
A6 FUNCTION GEN Circuit Board Assembly

REV. B, AUG 1974

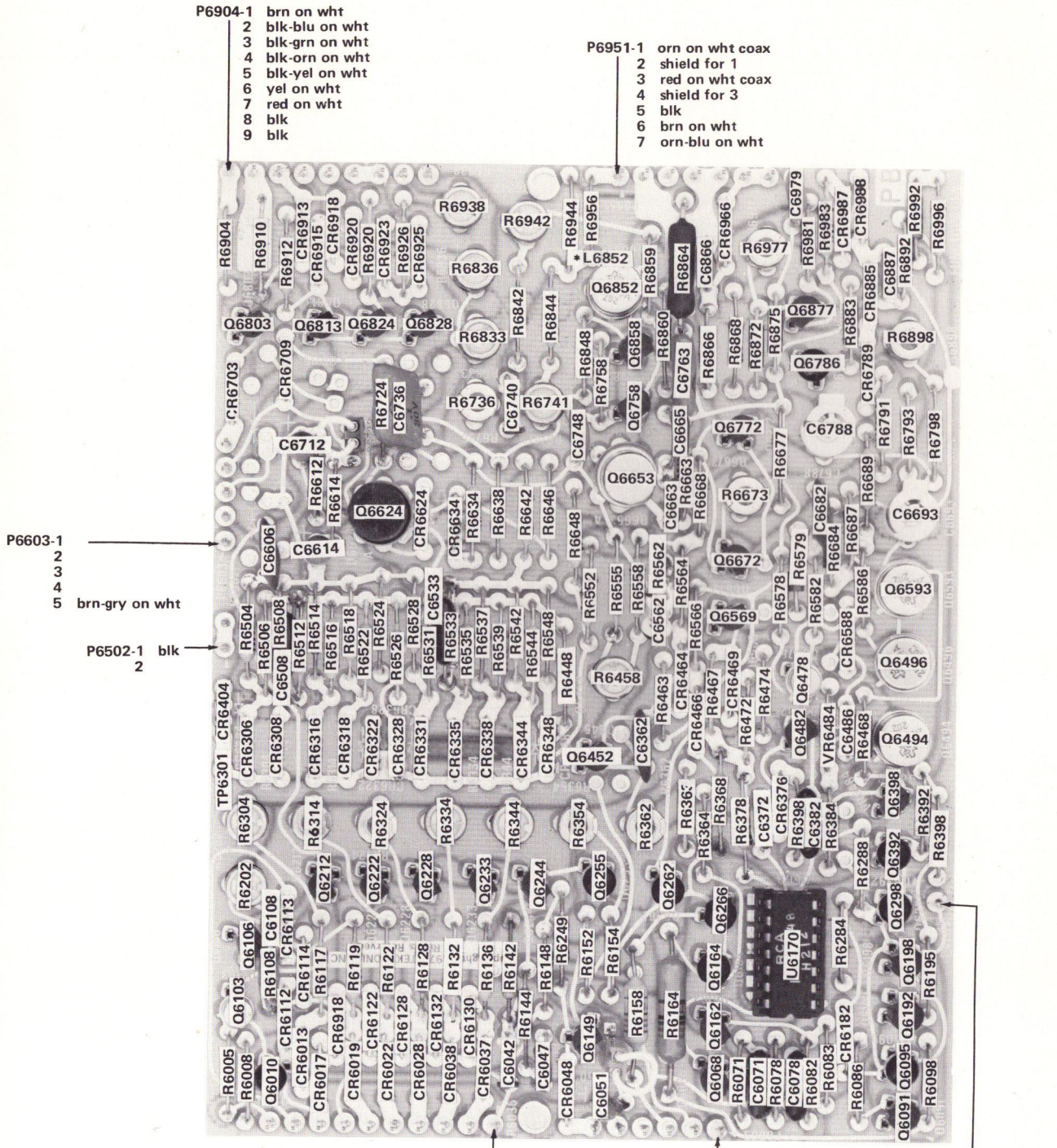


P/O A6 FUNCTION GEN CIRCUIT BOARD

1



Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field and the FULL FIELD SIG Mode switch set to MULTIBURST.



*See Parts List for serial number ranges.

A6 FUNCTION GEN Circuit Board Assembly

REV. B, AUG 1974

P/O A6 FUNCTION GEN CIRCUIT BOARD

DIODE SHAPER

SHAPER AMPLIFIER

SETUP

MULTIBURST PEDESTAL AMPLITUDE

WAVEFORMS

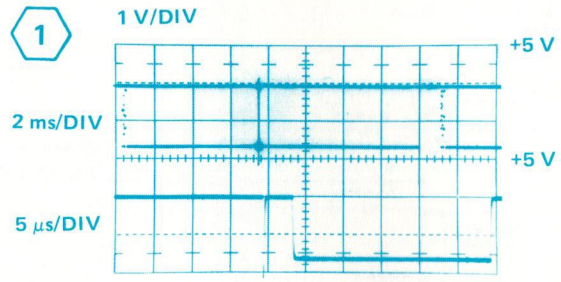
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

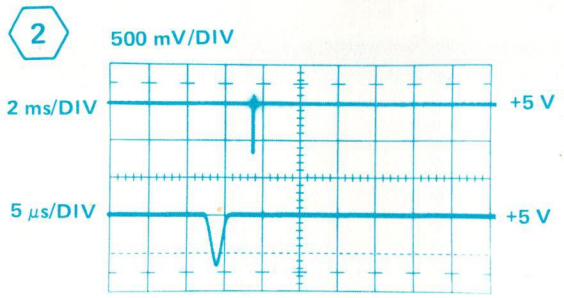
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

MB PEDESTAL

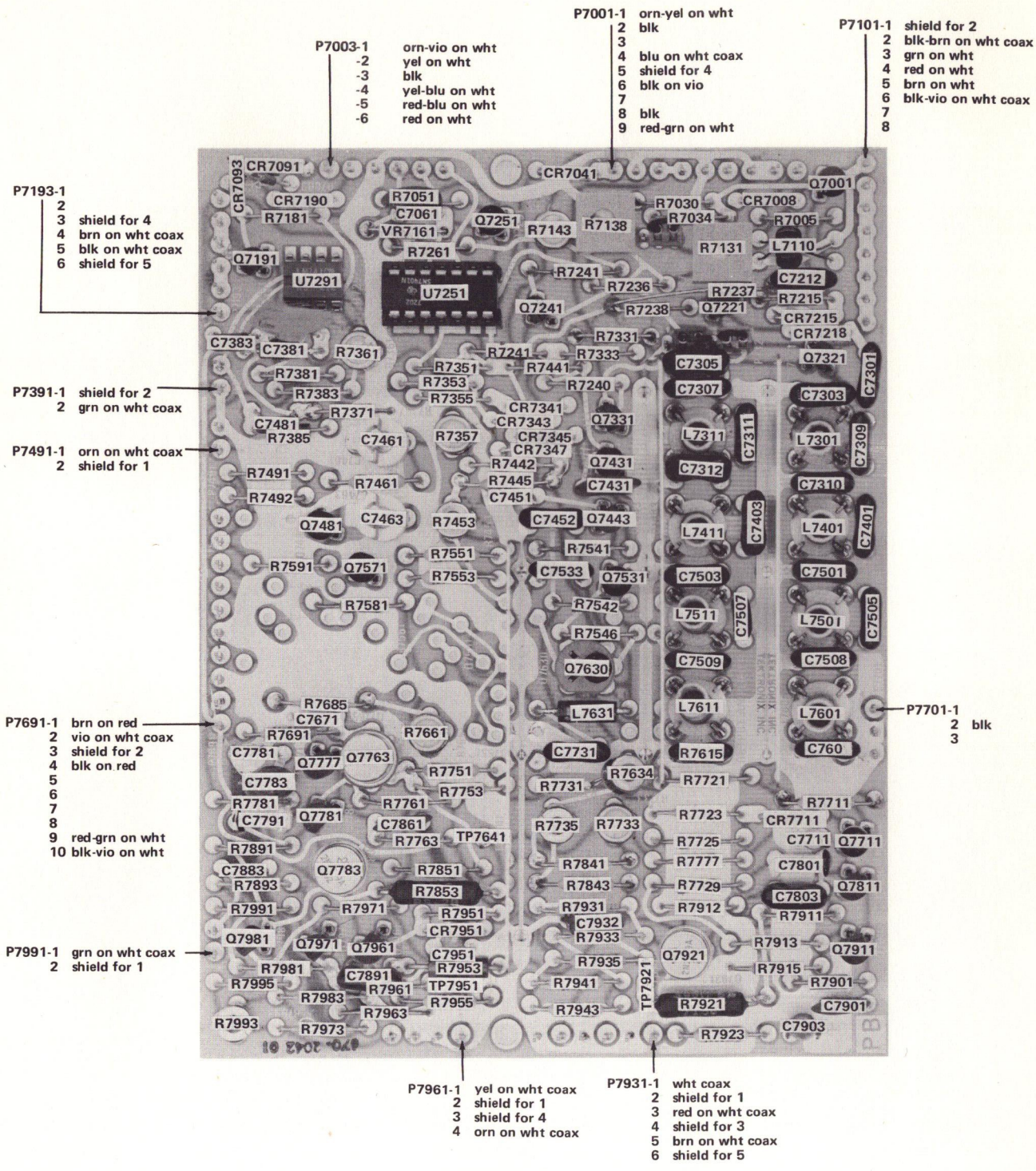
6b

MULTIBURST PEDESTALS 6b DAJ

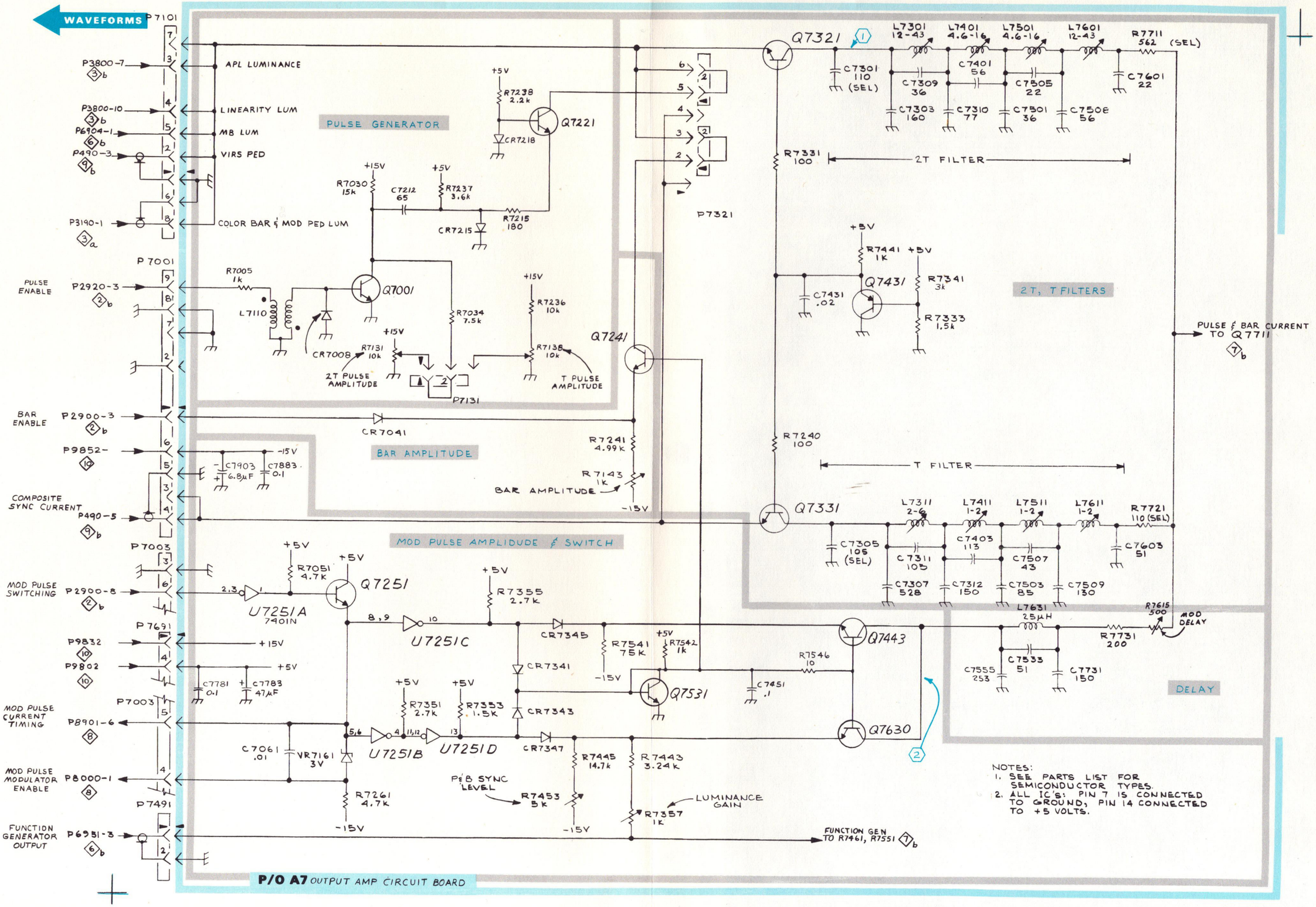




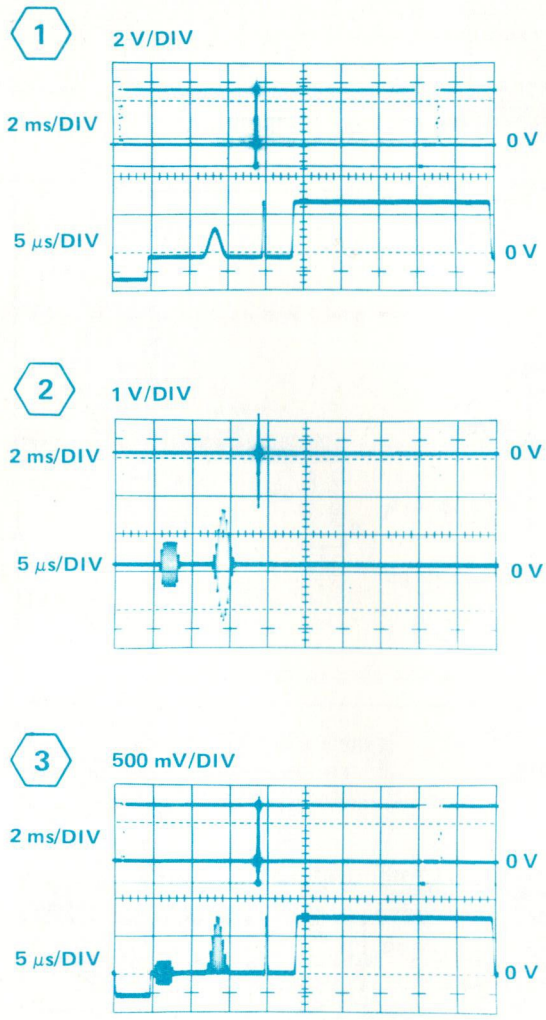
Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field.



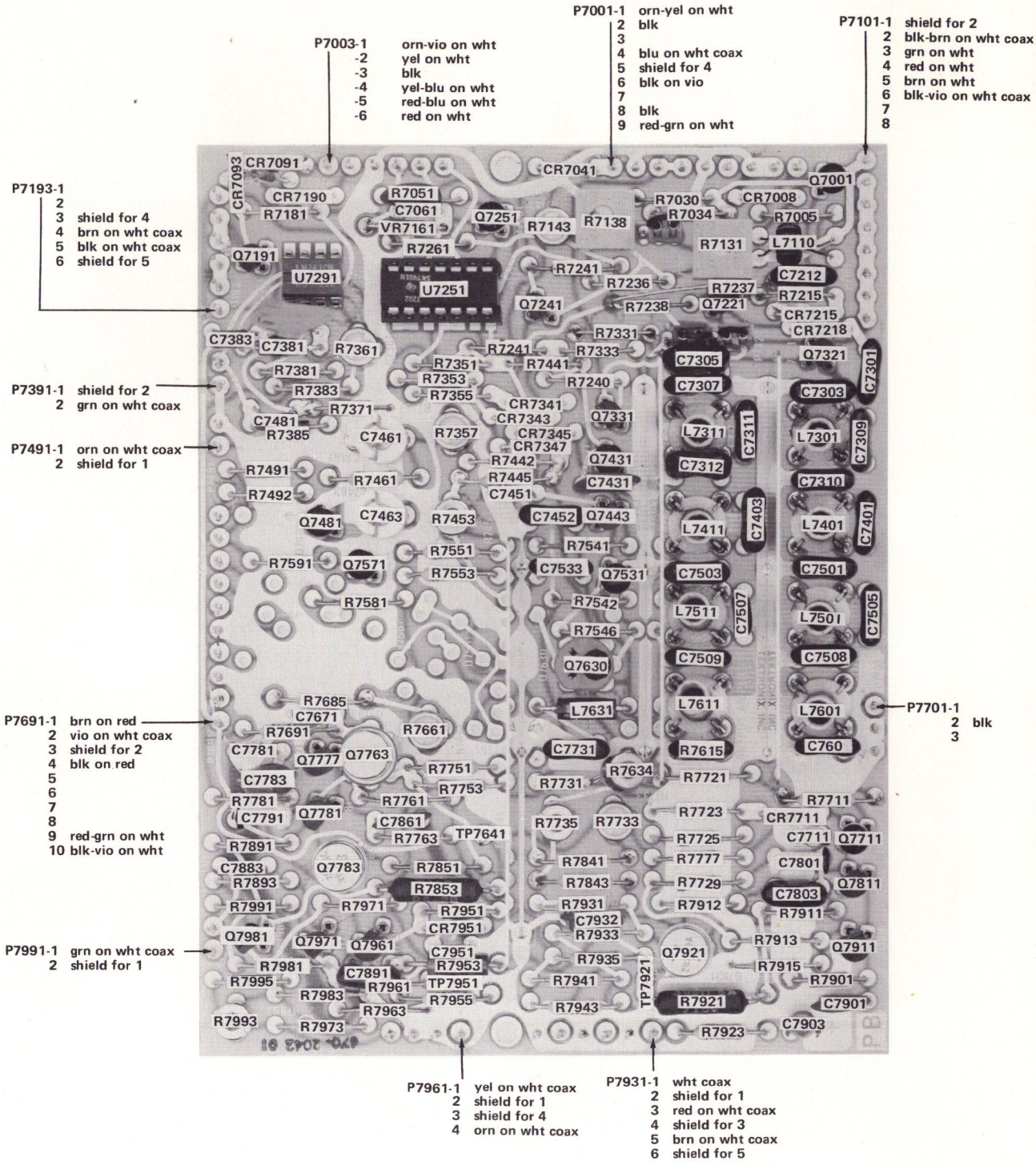
A7 OUTPUT AMP Circuit Board Assembly



P/O A7 OUTPUT AMP CIRCUIT BOARD

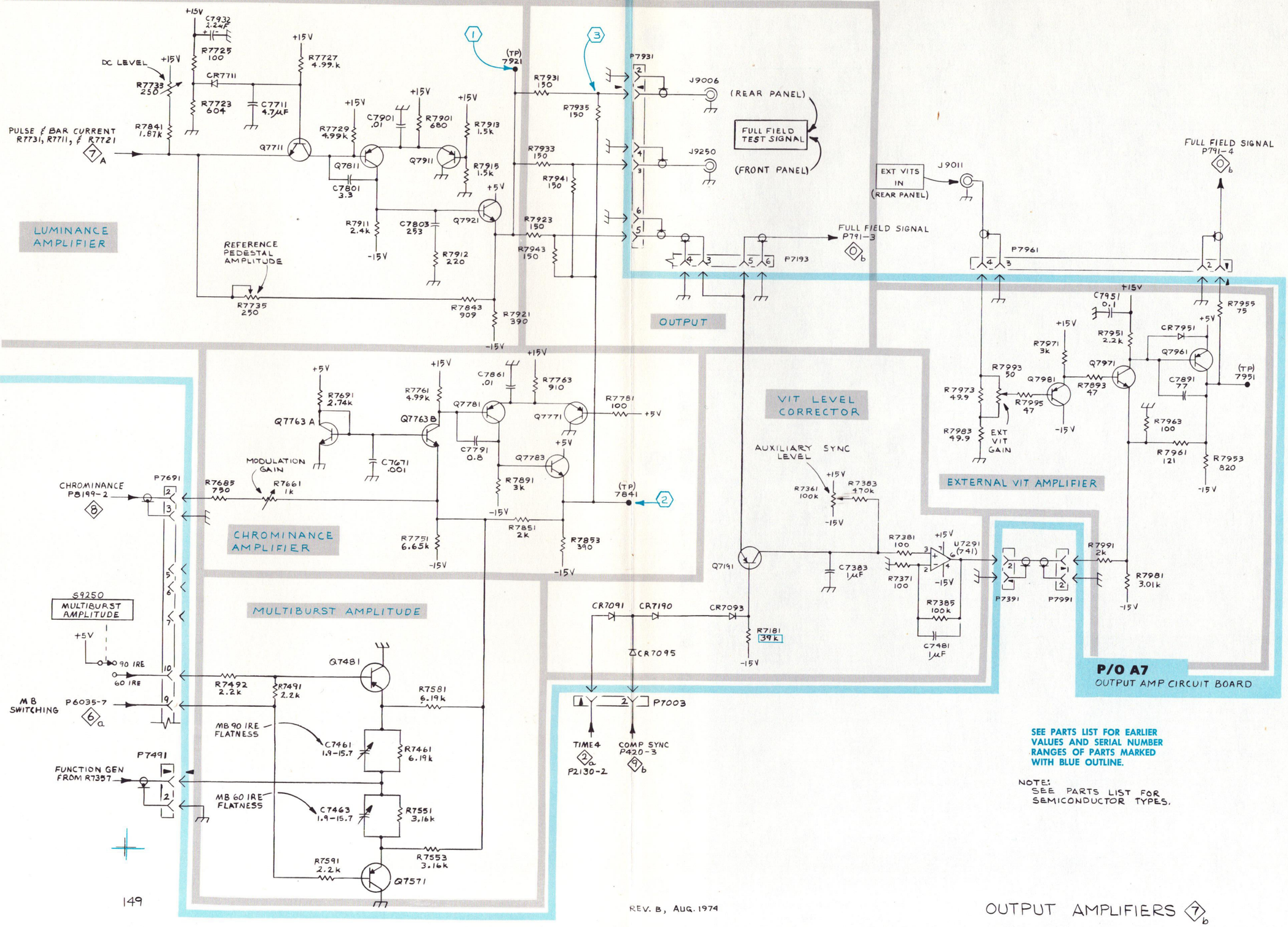


Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field.



A7 OUTPUT AMP Circuit Board Assembly

Ⓐ

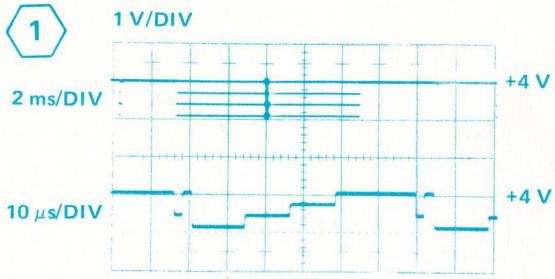


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

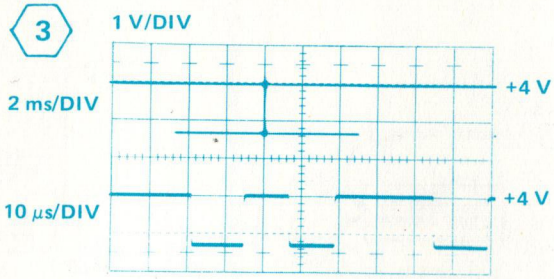
NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

REV. B, AUG. 1974

1



3



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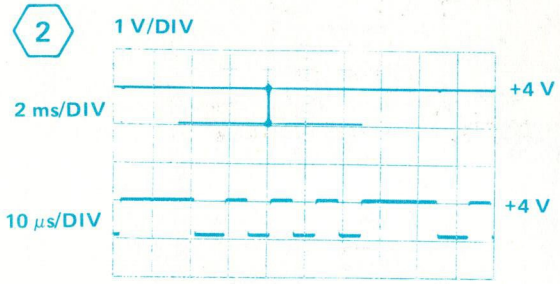

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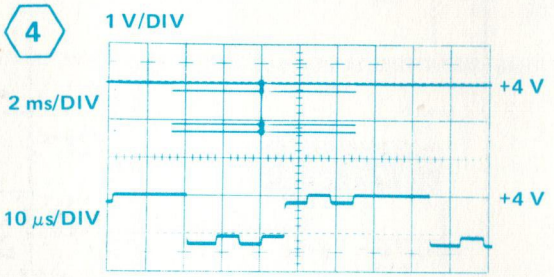

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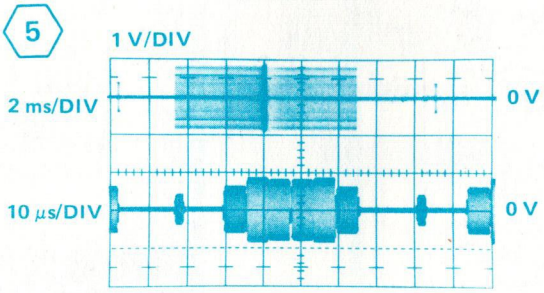
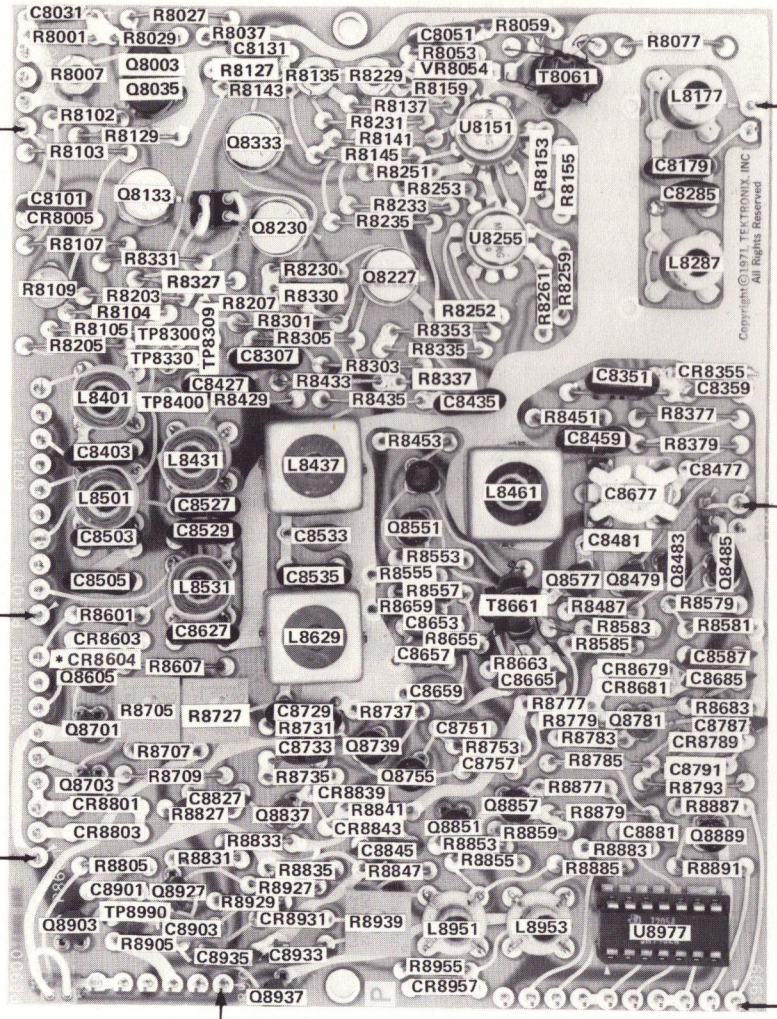


Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view any active line within the field and the FULL FIELD SIG Mode switch set to COLOR TEST SIGNAL.



P8000-1 yel-blu on wht
-2 shield for 3
-3 red on wht coax
4 blk

P8199-1 shield for 2
2 vio on wht coax

P8399-1 yel-blu on wht
2

P8400-1 shield for 2
2 blu on wht coax
3 shield for 4
4 blk-blu on wht coax
5 shield for 6
6 vio on wht coax
7 shield for 8
8 red on wht coax
9 shield for 10
10 blk-red on wht coax

P8600-1 blk
2 blu on wht
3 blk-gry on wht
4 blu-grn on wht
5
6
7 orn on wht
8 shield for 9
9 vio on wht coax

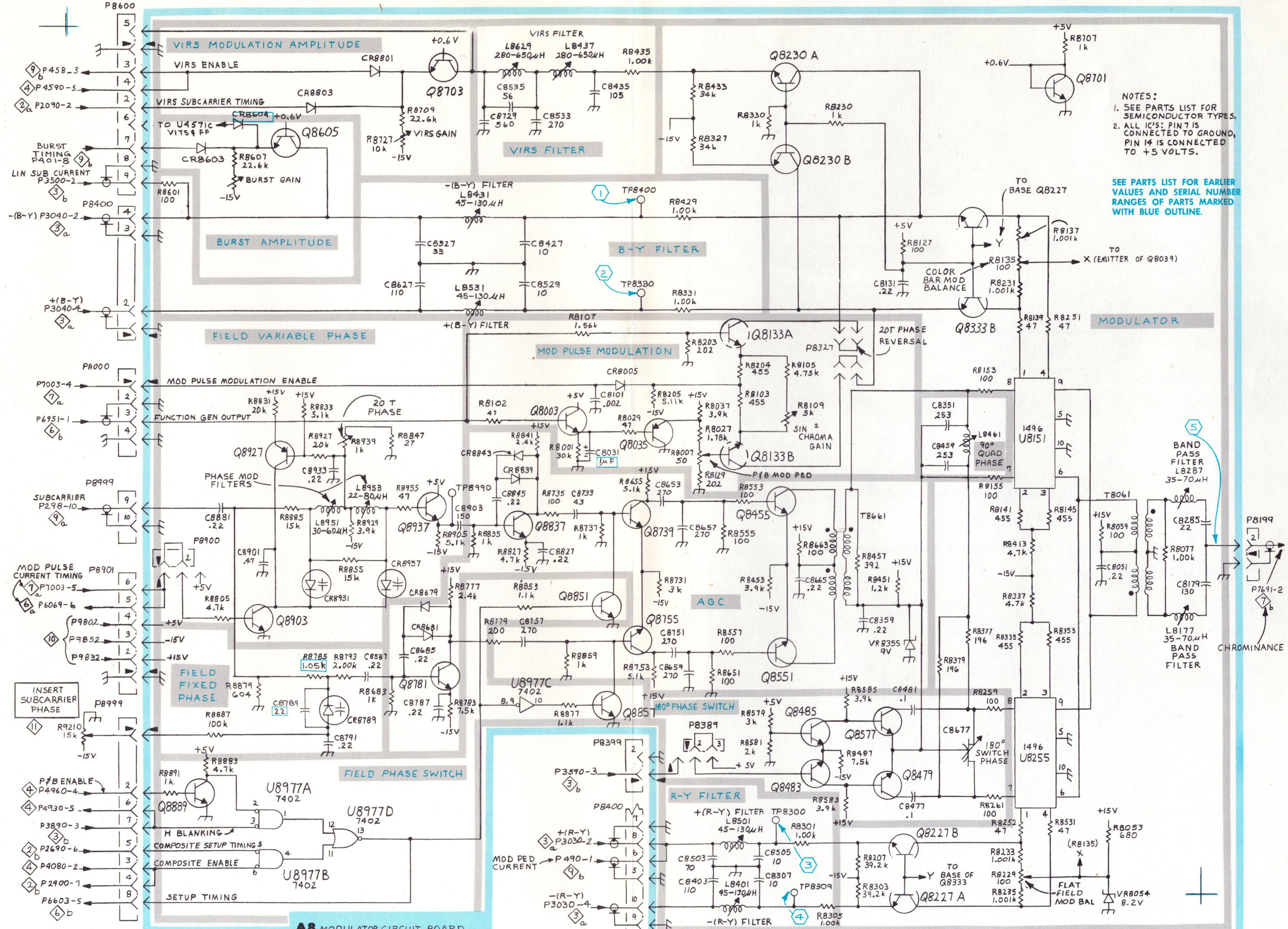
P8999-1 red on wht
-2 red-gry on wht
-3 red-vio on wht
-4 red-vio on wht
-5 blk-vio on wht
-6 yel on wht
-7 yel on wht
-8 brn-gry on wht
-9 blk-yel on wht coax
-10 shield for 9

P8901-1
2 brn on red
3 blk on vio
4 blk on red
5 red-blu on wht
6 red-blu on wht

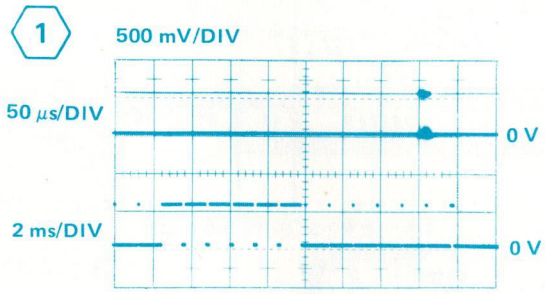
*See Parts List for serial number ranges.

A8 MODULATOR Circuit Board Assembly

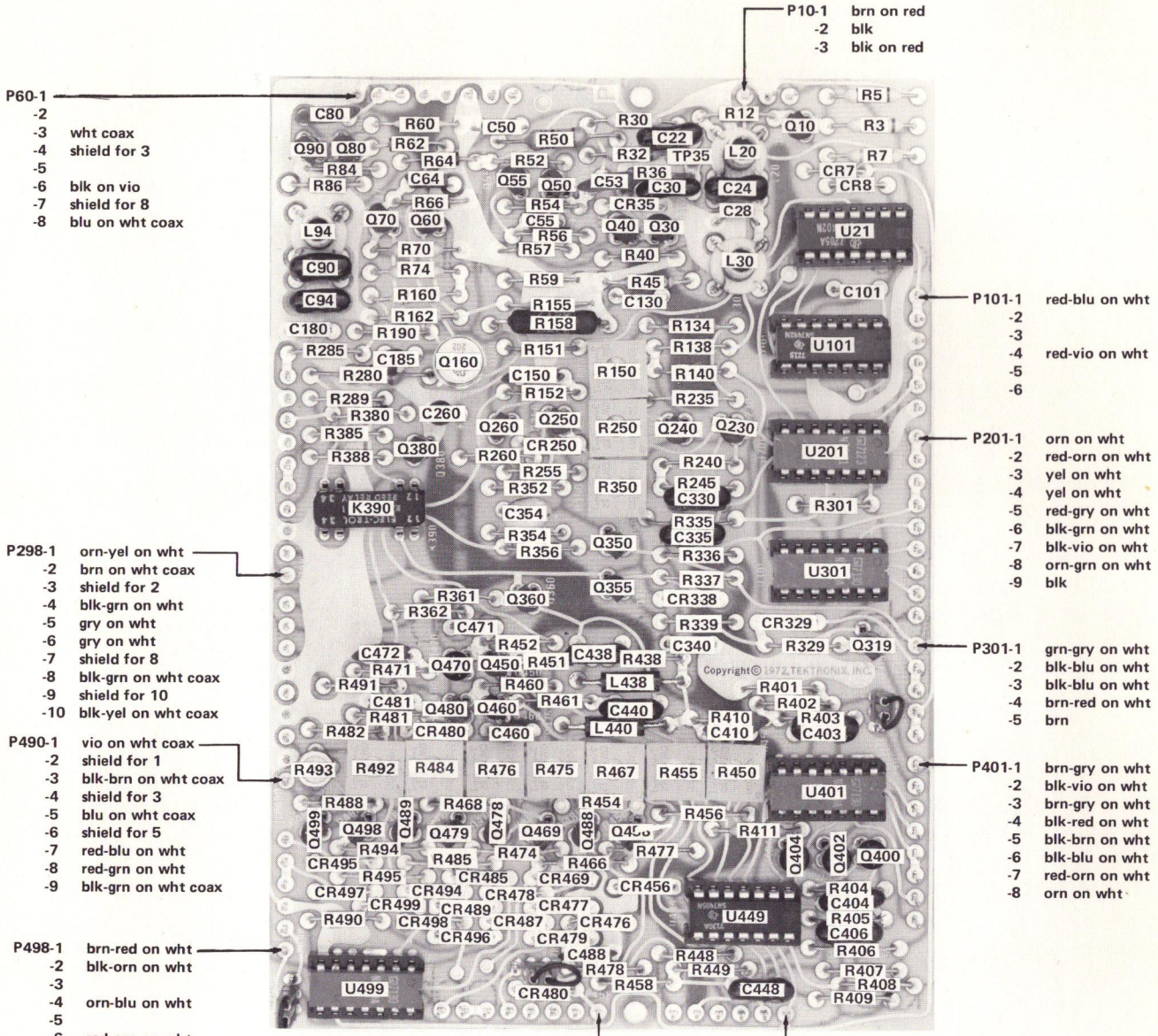
REV. B, AUG 1974



A8 MODULATOR CIRCUIT BOARD
VIRS MODULATION AMPLITUDE
VIRS ENABLE
VIRS SUBCARRIER TIMING
VIRS FILTER
VIRS GAIN
BURST GAIN
BURST AMPLITUDE
BURST TIMING
LIN SUB CURRENT
-(B-Y) FILTER
+(B-Y) FILTER
B-Y FILTER
FIELD VARIABLE PHASE
MOD PULSE MODULATION
MOD PULSE MODULATION ENABLE
FUNCTION GEN OUTPUT
20 T PHASE
20T PHASE REVERSAL
SIN 2 CHROMA GAIN
P/B MOD PED
PHASE MOD FILTERS
SUBCARRIER
MOD PULSE CURRENT TIMING
AGC
FIELD FIXED PHASE
INSERT SUBCARRIER PHASE
FIELD PHASE SWITCH
180° PHASE SWITCH
180° SWITCH PHASE
90° QUAD PHASE
R-Y FILTER
+(R-Y) FILTER
-(R-Y) FILTER
MOD PED CURRENT
P/B ENABLE
H BLANKING
COMPOSITE SETUP TIMING
COMPOSITE ENABLE
SETUP TIMING
COLOR BAR MOD BALANCE
FLAT FIELD MOD BAL
MODULATOR
BAND PASS FILTER
CHROMINANCE
TO BASE Q8227
TO BASE OF Q8333
X (EMITTER OF Q8039)
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. ALL IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 IS CONNECTED TO +5 VOLTS.
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

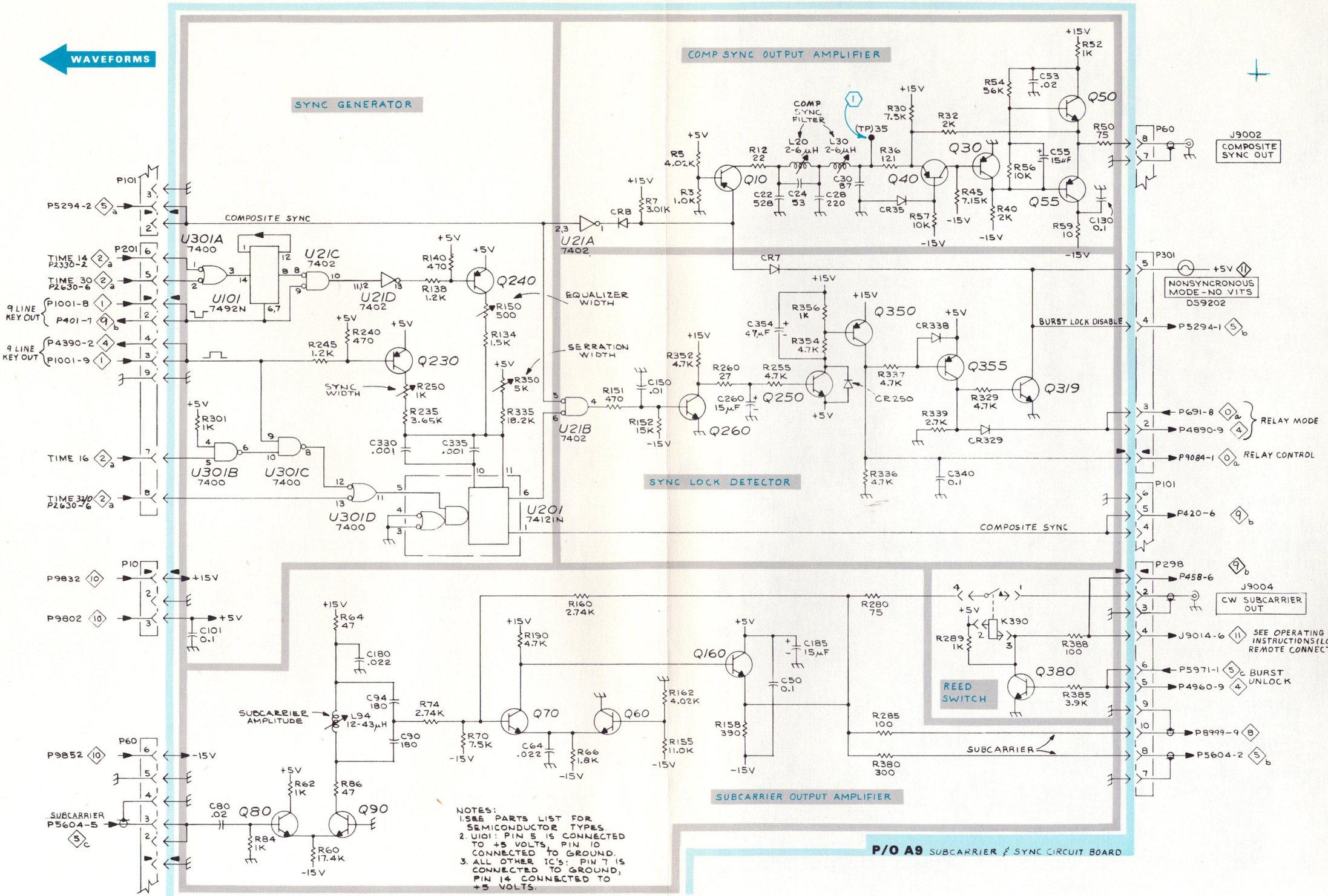


Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view the vertical equalizing and serration pulses



A9 SUBCARRIER & SYNC Circuit Board

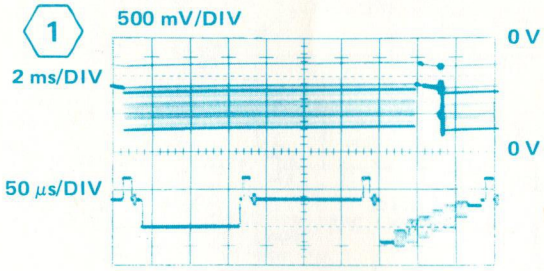
REV. B, AUG 1974

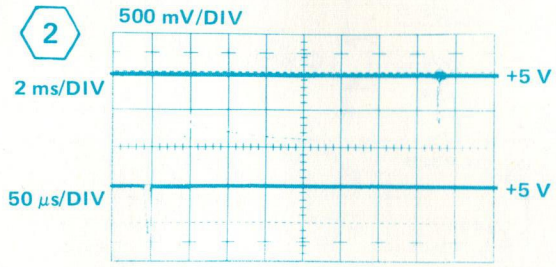


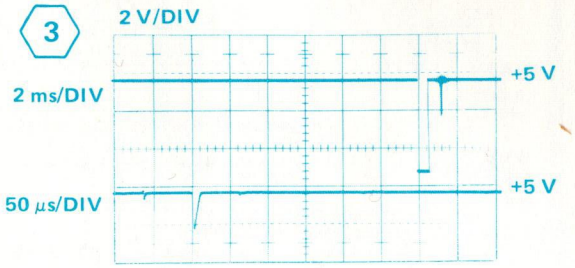
REV. B, MAR. 1975

SYNC & SUBCARRIER OUTPUT AMPLIFIERS 9a

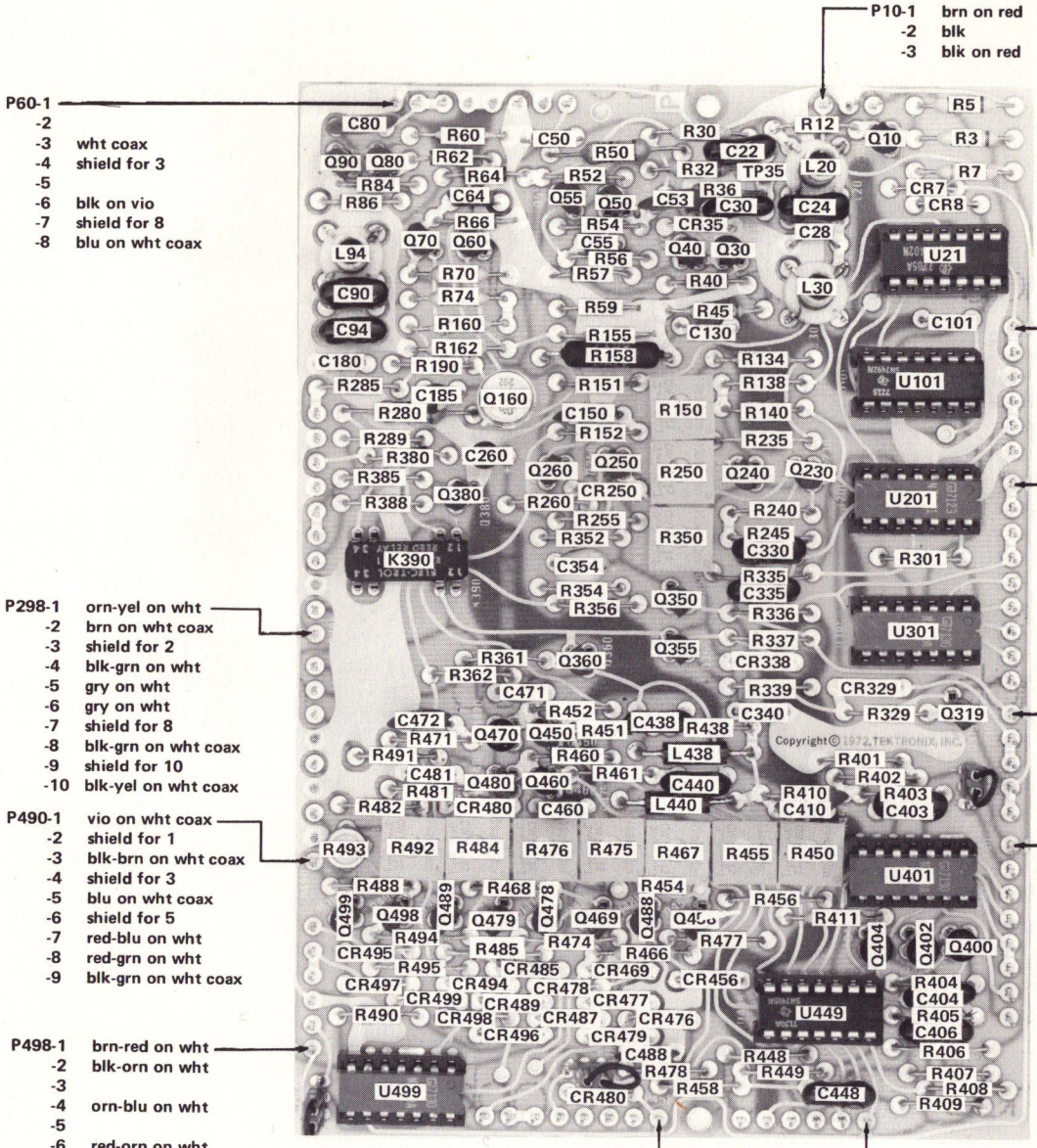
DAJ 8-22-72





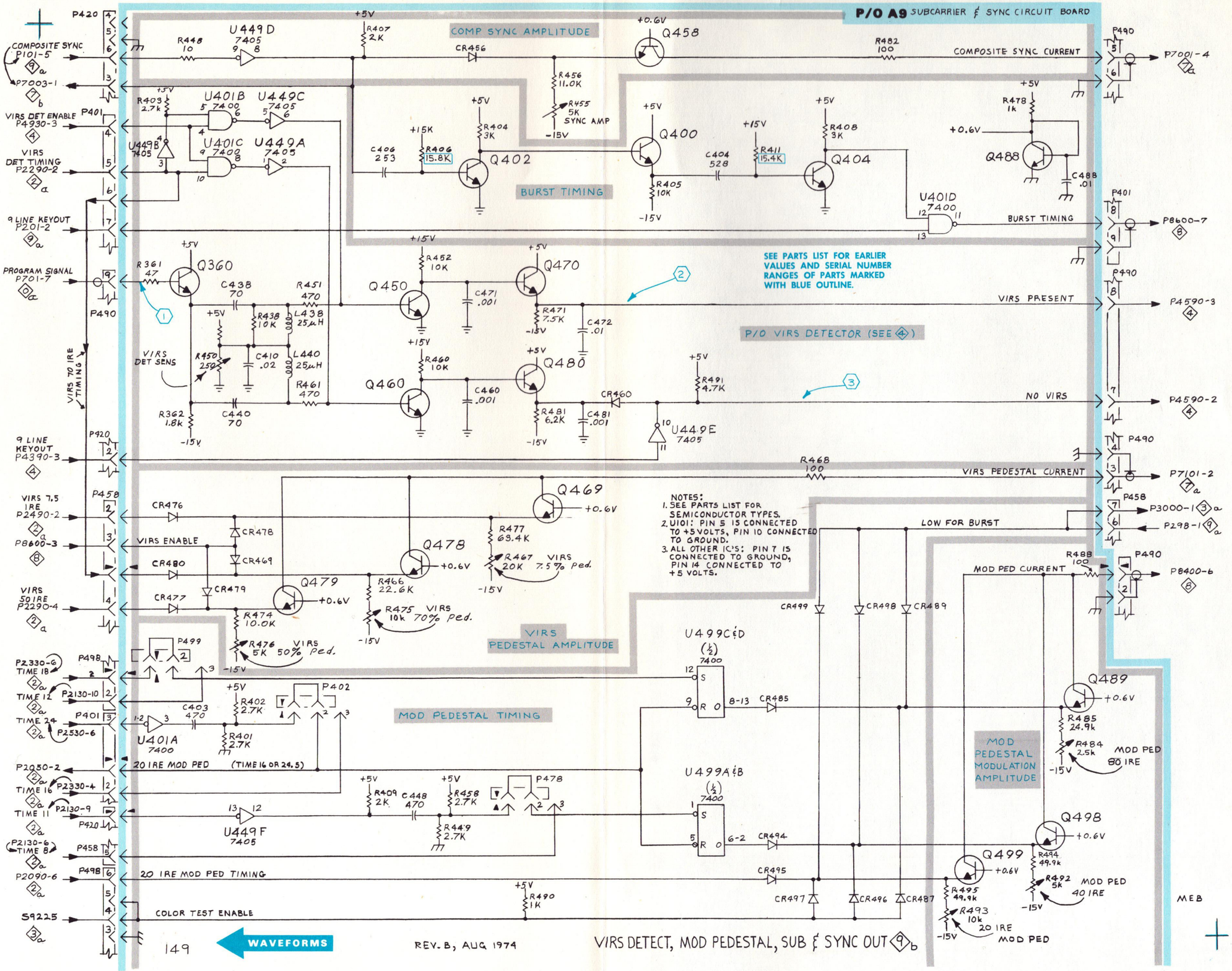


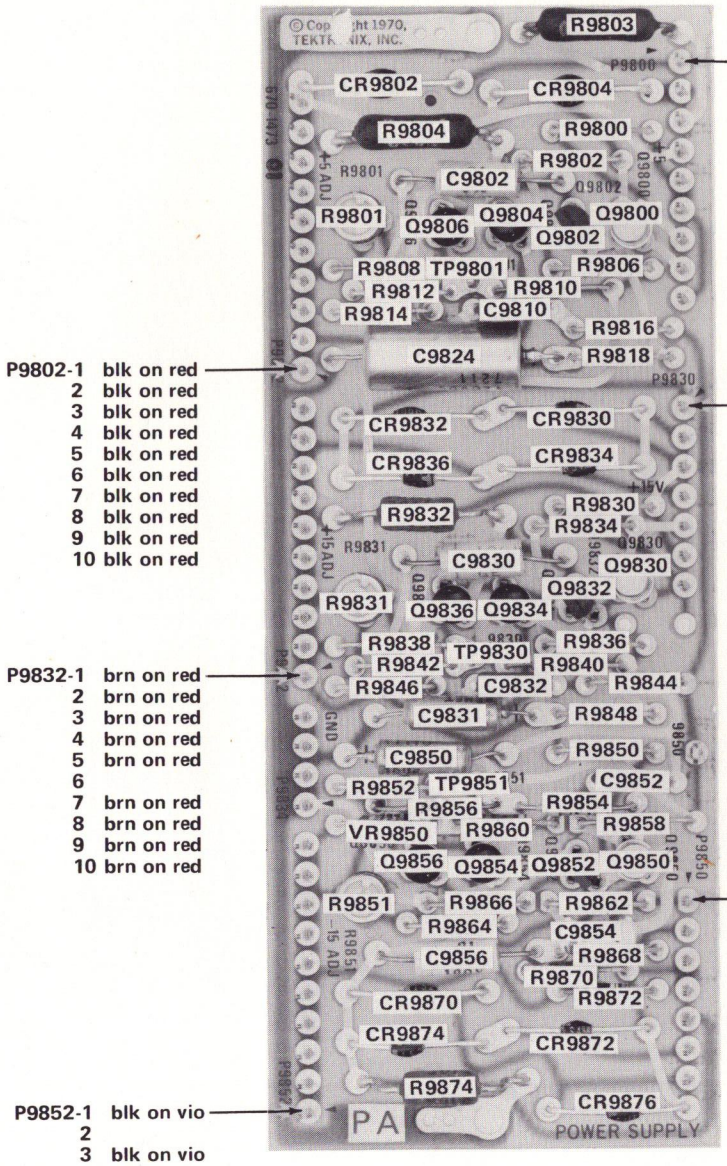
Waveforms and Voltages obtained under conditions given on the Diagram Title page except: All waveforms, DTM set to view the vertical equalizing and serration pulses.



A9 SUBCARRIER & SYNC Circuit Board

REV. B, AUG 1974


P/O A9 SUBCARRIER & SYNC CIRCUIT BOARD
COMP SYNC AMPLITUDE
BURST TIMING
P/O VIRS DETECTOR (SEE 4)
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
VIRS PEDESTAL AMPLITUDE
MOD PEDESTAL TIMING
MOD PEDESTAL MODULATION AMPLITUDE
COMPOSITE SYNC P101-5
P7003-1
VIRS DET ENABLE P4930-3
VIRS DET TIMING P2290-2
9 LINE KEYOUT P201-2
PROGRAM SIGNAL P701-7
VIRS TO IRE TIMING
VIRS DET SENS
9 LINE KEYOUT P4390-3
VIRS 7.5 IRE P2490-2
P8600-3
VIRS 50 IRE P2290-4
P2330-6 TIME 18
P2130-10 TIME 12
TIME 24 P2530-6
P2050-2
P2330-4 TIME 16
P2130-9 TIME 11
P2130-6 TIME 8
P2090-6
S9225
20 IRE MOD PED
(TIME 16 OR 24.5)
20 IRE MOD PED TIMING
COLOR TEST ENABLE
COMPOSITE SYNC CURRENT
VIRS PRESENT
NO VIRS
VIRS PEDESTAL CURRENT
LOW FOR BURST
MOD PED CURRENT
P7001-4
P8600-7
P4590-3
P4590-2
P7101-2
P3000-1
P298-1
P8400-6
MOD PED 80 IRE
MOD PED 40 IRE
MOD PED 20 IRE
MEB
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. U101: PIN 5 IS CONNECTED TO +5 VOLTS, PIN 10 CONNECTED TO GROUND.
3. ALL OTHER IC'S: PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.



P9800-1 blk-blu on gry
2 brn on gry
3 yel on brn
4 blk on red
5 orn on brn
6 blk-vio on gry
7 blk on wht
8 yel on wht
9 grn on wht

P9802-1 blk on red
2 blk on red
3 blk on red
4 blk on red
5 blk on red
6 blk on red
7 blk on red
8 blk on red
9 blk on red
10 blk on red

P9830-1 brn-orn on gry
2 brn-yel on gry
3 orn on wht
4 brn on red
5 red on wht
6 orn on wht
7 vio on wht

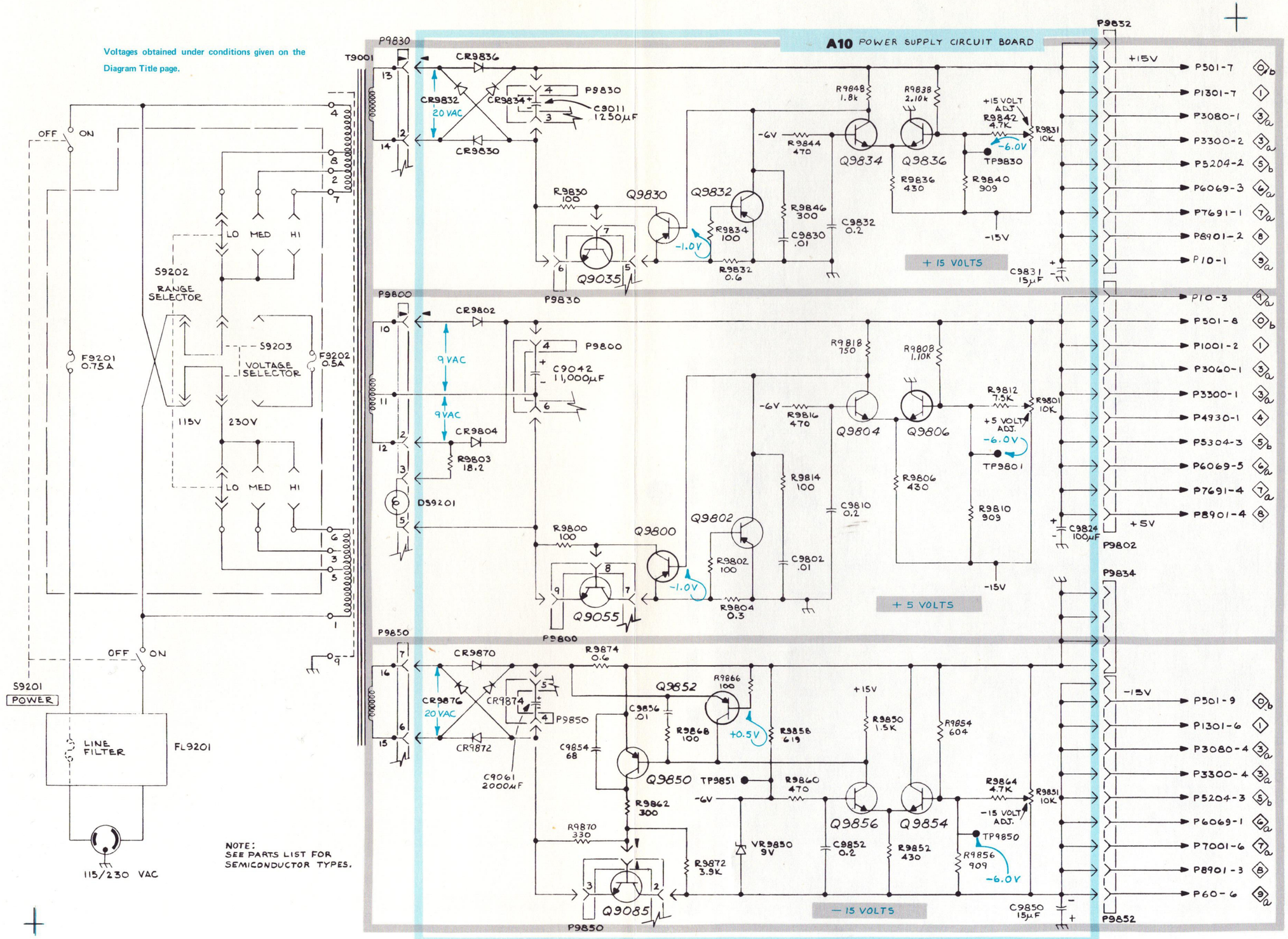
P9832-1 brn on red
2 brn on red
3 brn on red
4 brn on red
5 brn on red
6
7 brn on red
8 brn on red
9 brn on red
10 brn on red

P9850-1 gry on wht
2 blk on vio
3 blk-wht on vio
4 blk-wht on vio
5 blu on wht
6 brn-blu on gry
7 brn-grn on gry

P9852-1 blk on vio
2
3 blk on vio
4 blk on vio
5 blk on vio
6 blk on vio
7 blk on vio
8 blk on vio
9 blk on vio
10 blk on vio

A10 POWER SUPPLY Circuit Board

Voltages obtained under conditions given on the Diagram Title page.



NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PROGRAM CONTROL

NONSYNCHRONOUS MODE – NO VITS

+5V (DCPL) → DS9202 → P301-5 ◇9a

POWER ON: P9800-5 ◇10 → DS9201 → P9800-3 ◇10

S9201 POWER: FL9201 ◇10 → OFF / ON → T9001 ◇10

S9205 UNITY GAIN/VAR

P501-3 ◇9a → UNITY GAIN → P501-5 ◇9a

VAR → R9205 1.5k LEVEL → P501-1 ◇9a

P4390-1 ◇4 → DS9210 +5V (DCPL) → PROGRAM

P4390-4 ◇4 → DS9211 +5V (DCPL) → PREVIEW

+5V → R9209 10k INSERT DELAY → P1791-1 ◇1

S9213 PROGRAM/PREVIEW AUXILIARY

P701-8 ◇9a → PROGRAM / PREVIEW / AUXILIARY

S9212 REMOTE/LOCAL: LOCAL → P701-3 ◇9b; REMOTE

P801-4 ◇9a → R9215 5k AUXILIARY PEDESTAL → P801-3 ◇9a; C9215 0.1

P801-2 ◇9a → J9210 ◇9b → P701-5 ◇9b

P591-6 ◇9b

P991-2 ◇9a

P971-2 ◇9a → P691-9 ◇9a

INSERT SUBCARRIER PHASE → R9210 15k → -15V; P8999-1 ◇8

VITS INSERTION

+5V (DCPL)

DS9221 VIRS INCOMING ← P4390-9 ◇4

DS9220 VIRS DELETE ← P4390-7 ◇4

DS9222 VIRS INSERT ← P4080-1 ◇4

COLOR TEST SIGNAL

S9225 COLOR TEST SIGNAL

P4060-4 ◇4 → COLOR BARS → P3000-7 ◇3a

MOD PEDESTAL → P498-4 ◇9b

50 IRE PEDESTAL

+5V → P3090-3 ◇3a; P3090-1

S9230 COLOR TEST SIGNAL

SPLIT FIELD → P3000-6 ◇3a

FULL FIELD

MULTIBURST

S9250 MULTIBURST AMPLITUDE

+5V → 90 IRE / 60 IRE → P7691-10 ◇7b

-15V → P6904-2 ◇6b

LINEARITY

S9255 SUBCARRIER

+5V → ON / OFF → P3500-4 ◇3b

S9270 MODE

5 STEP → P3960-7; 10 STEP → P3960-8; RAMP → P3960-6 ◇3b

FULL FIELD SIGNAL

FACTORY CONNECTED

TO PREVENT VIRS, DISCONNECT PIN 21.

P9014 (1, 12, 13, 20, 21, 24)

J9014 REMOTE

P298-4 ◇9a

P991-2 ◇9a; P4590-8 ◇4; P4960-2 ◇4; P4890-6 ◇4; P971-2 ◇9a; P4890-5 ◇4

MODE S9260: SIN² PULSE & BAR → P4890-2 ◇4; WINDOW → P4890-3 ◇4; COLOR TEST SIG → P4060-1 ◇4

MULTIBURST → P4890-8 ◇4

LINEARITY → P4890-4 ◇4

FIELD SQ WAVE → P4930-8 ◇4

FLAT FIELD → P4080-3 ◇4

COMPOSITE → P4390-10 ◇4

P3800-1 ◇3b

R9291 583 / R9292 732 / R9293 931 / R9294 1.24k / R9295 1.76k / R9296 2.61k / R9297 4.32k / R9298 8.76k / R9299 26.4k

-15V; 100 90 80 70 60 50 40 30 20 10 0 50

APL VARIABLE S9290

APL RATE: R9280 500k → P3890-1 ◇3b; +5V → P3890-2 ◇3b

APL MODE S9285 → BOUNCE 10-90; VARIABLE P3930-5 ◇3b

S9000 SYNC SOURCE (REAR-PANEL)

P9082-1 ◇9a

P5062-1 ◇5a

R9002 ◇9a

SECTION 8

MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

FIGURE 1 FRONT & CABINET

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	366-0500-00			2		KNOB, gray--FULL FIELD SIGNAL & APL VARIABLE
	- - - - - -			-		each knob includes:
	213-0153-00			2		SETSCREW, 5-40 x 0.125 inch, HSS
-2	366-0215-02			9		KNOB, lever switch
-3	366-1189-00			2		KNOB, gray--LEVEL & AUXILIARY PEDISTAL
	- - - - - -			-		each knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-4	333-1689-00			1		PANEL, front
	- - - - - -			-		mounting hardware: (not included w/panel)
-5	211-0107-00			4		SCREW, 1-72 x 0.312 inch, RHS
-6	367-0102-00			2		HANDLE, carrying
	- - - - - -			-		mounting hardware for each: (not included w/handle)
-7	212-0004-00			2		SCREW, 8-32 x 0.312 inch, PHS
-8	213-0216-00			2		THUMBSCREW, 10-32 x 0.375 inch
	- - - - - -			-		mounting hardware for each: (not included w/thumbscrew)
-9	354-0025-00			1		RING, retaining
-10	210-0894-00			1		WASHER, plastic, 0.19 ID x 0.438 inch OD
-11	124-0270-00			1		STRIP, trim, right
-12	124-0270-01			1		STRIP, trim, left
-13	407-0510-00			2		BRACKET, angle
	- - - - - -			-		mounting hardware for each: (not included w/bracket)
-14	212-0004-00			2		SCREW, 8-32 x 0.312 inch, PHS
-15	351-0104-00			1		SLIDE, section (pair)
	- - - - - -			-		mounting hardware: (not included w/slide)
-16	212-0004-00			4		SCREW, 8-32 x 0.312 inch, PHS

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-17	390-0309-00			1	CABINET TOP
	- - - - - -			-	cabinet top includes:
-18	355-0134-00			2	STUD, turnlock fastener, FHS
-19	355-0135-01			12	STUD, turnlock fastener, OHS
-20	214-0389-00			14	FASTENER, retainer
-21	200-1394-01			1	DOOR, access
	- - - - - -			-	door includes:
-22	355-0135-01			1	STUD, turnlock fastener, OHS
-23	214-0389-00			1	FASTENER, retainer
	- - - - - -			-	mounting hardware: (not included w/cover)
-24	210-0586-00			3	NUT, keps, 4-40 x 0.25 inch
-25	390-0063-00			1	CABINET BOTTOM
	- - - - - -			-	cabinet bottom includes:
-26	355-0134-00			2	STUD, turnlock fastener, FHS
-27	355-0135-01			12	STUD, turnlock fastener, OHS
-28	214-0389-00			14	FASTENER, retainer
-29	136-0079-00			1	SOCKET ASSEMBLY, w/green jewel & hardware
-30	131-0106-02			2	CONNECTOR, receptacle, female, BNC, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-31	210-0255-00			1	TERMINAL, lug, 0.391 inch ID, SE
-32	260-1374-00			1	SWITCH, rotary--APL VARIABLE, unwired (S9290)
	- - - - - -			-	mounting hardware: (not included w/switch)
-33	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-34	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-35	260-1250-00			1	SWITCH, rotary--FULL FIELD SIGNAL, unwired (S9260)
	- - - - - -			-	mounting hardware: (not included w/switch)
-36	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-37	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-38	260-0276-00			1	SWITCH, toggle--POWER (S9201)
	- - - - - -			-	mounting hardware: (not included w/switch)
-39	210-0473-00			1	NUT, dodecagon, 0.468-32 x 0.638 inch
-40	210-0902-00			1	WASHER, flat, 0.47 ID x 0.656 inxh OD
-41	354-0055-00			1	RING, locking
-42	337-1155-00			1	SHIELD, switch
-43	210-0414-00			1	NUT, hex., 0.468-32 x 0.562 inch
-44	- - - - - -			1	RESISTOR, variable (See R9205 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/resistor)
-45	210-0583-00			2	NUT, hex., 0.25-32 x 0.312 inch
-46	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-47	- - - - - -			1	RESISTOR, variable (See R9215 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/resistor)
-48	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-49	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-50	- - - - - -			1	RESISTOR, variable (See R9209 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/resistor)
-51	358-0422-00			1	BUSHING, 0.25-32 x 0.188 inch
-52	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-53	220-0484-00			1	NUT, hex., 0.25-32 x 0.312 x 0.375 inch long
-54	- - - - - -			1	RESISTOR, variable (See R9210 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/resistor)
-55	358-0409-00			1	BUSHING, 0.25-32 x 0.207 inch long
-56	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-57	210-0471-00			1	POST, hex., 0.25-32 x 0.312 x 0.594 inch long
-58	- - - - - -			1	RESISTOR, variable (See R9280 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/resistor)
-59	358-0422-00			1	BUSHING, 0.25-32 x 0.188 inch
-60	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-61	220-0484-00			1	NUT, hex., 0.25-32 x 0.312 x 0.375 inch long
-62	210-0465-00			1	NUT, hex., 0.25-32 x 0.375 inch
-63	333-1651-00			1	PANEL, front
-64	358-0301-00			3	BUSHING, sleeve, plastic
-65	260-0731-00			1	SWITCH, lever--APL MODE (S9285)
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-66	260-0621-00			1	SWITCH, lever--LINEARITY MODE (S9270)
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-67	260-0731-00			1	SWITCH, lever--LINEARITY SUBCARRIER (S9255)
	- - - - - -			-	mounting hardware: (not included w/switch)
-68	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-69	260-0664-00			1	SWITCH, lever--MULTIBURST AMPLITUDE (S9250)
	- - - - - -			-	mounting hardware: (not included w/switch)
-70	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long

FIGURE 1 FRONT & CABINET (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
1-71	260-0731-00			1	SWITCH, lever--COLOR TEST SIGNAL (S9230)
	- - - - - -			-	mounting hardware: (not included w/switch)
-72	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-73	260-1494-00			1	SWITCH, lever--COLOR TEST SIGNAL (S9225)
	- - - - - -			-	mounting hardware: (not included w/switch)
-74	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-75	260-1248-00			1	SWITCH, lever--REMOTE/LOCAL (S9212)
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-76	260-1249-00			1	SWITCH, lever--PROGRAM/PREVIEW/AUXILIARY (S9213)
	- - - - - -			-	mounting hardware: (not included w/switch)
	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-77	260-0731-00			1	SWITCH, lever--UNITY GAIN/VARIABLE (S9205)
	- - - - - -			-	mounting hardware: (not included w/switch)
-78	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-79	200-0935-00			6	CAP, lampholder
-80	378-0602-02			2	LENS, indicator light, red
-81	378-0602-00			2	LENS, indicator light, green
-82	378-0602-01			2	LENS, indicator light, amber
-83	352-0157-01			6	HOLDER, lamp
-84	390-0066-00			1	CABINET SIDE, left
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-85	211-0538-00			11	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
	210-0457-00			11	NUT, keps, 6-32 x 0.312 inch
-86	390-0307-00			1	CABINET SIDE, right
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-87	211-0538-00			11	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-88	210-0457-00			11	NUT, keps, 6-32 x 0.312 inch
-89	386-1987-00			1	SUBPANEL, front

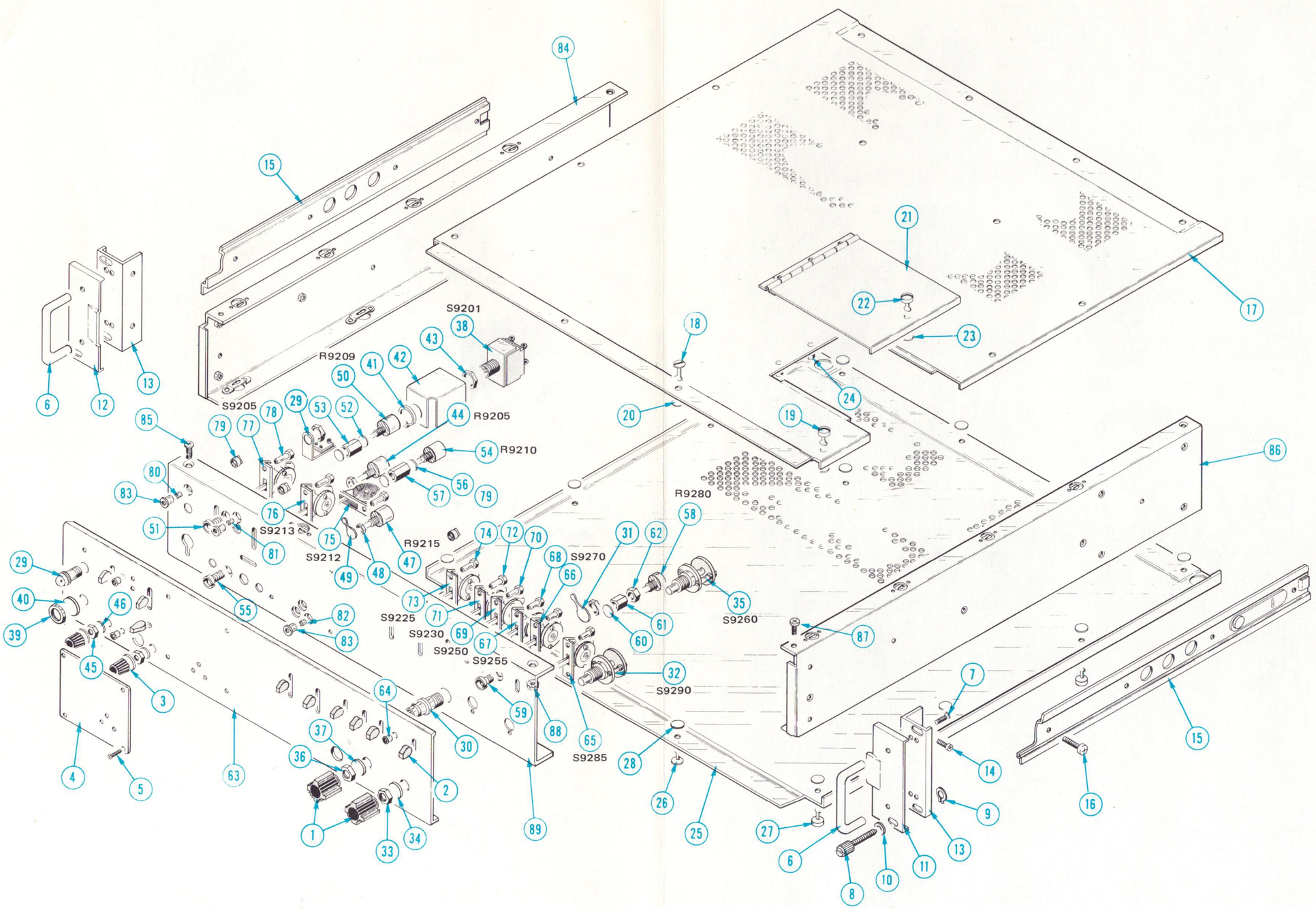

S9201
R9209
S9205
R9205
R9210
S9213
S9212
R9215
R9280
S9270
S9225
S9230
S9250
S9255
S9260
S9290
S9285

FIG. 2 CHASSIS

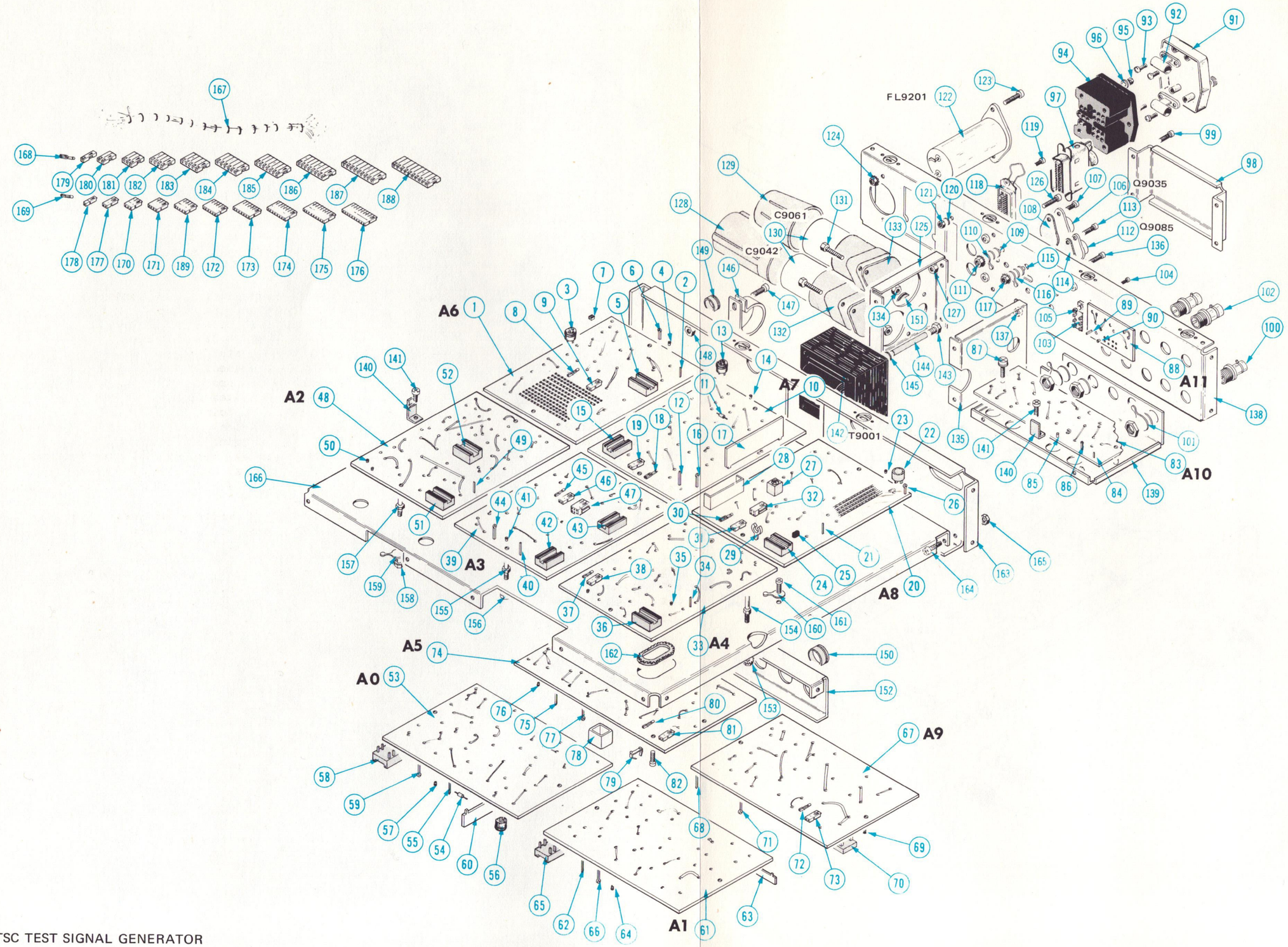


FIGURE 2 CHASSIS

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-1	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--FUNCTION GEN (See A6
	- - - - - -			-	Electrical Parts List)
	- - - - - -			-	circuit board assembly includes:
-2	131-0589-00			40	TERMINAL, pin, 0.46 inch long
	131-0608-00			6	TERMINAL, pin, 0.365 inch long
-3	136-0235-00			2	SOCKET, transistor, 6 pin
-4	136-0252-04			120	SOCKET, pin connector
-5	136-0269-00			1	SOCKET, integrated circuit, 14 pin
-6	214-0579-00			1	TERMINAL, test point
-7	344-0108-00			8	CLIP, electrical
-8	131-0707-00			4	CONNECTOR, terminal
-9	352-0169-03			1	HOLDER, terminal connector, 2 wire (orange)
	352-0169-07			1	HOLDER, terminal connector, 2 wire (violet)
-10	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--OUTPUT AMP (See A7 Electrical
	- - - - - -			-	Parts List)
	- - - - - -			-	circuit board assembly includes:
-11	131-0566-00			1	LINK, terminal connecting
-12	131-0589-00			58	TERMINAL, pin, 0.46 inch long
	131-0608-00			9	TERMINAL, pin, 0.365 inch long
-13	136-0235-00			2	SOCKET, transistor, 6 pin
-14	136-0252-04			74	SOCKET, pin connector
	136-0352-00			32	SOCKET, pin connector
-15	136-0269-00			1	SOCKET, integrated circuit, 14 pin
-16	214-0579-00			3	TERMINAL, test point
-17	337-1456-00			3	SHIELD, electrical
-18	131-0707-00			4	CONNECTOR, terminal
-19	352-0169-07			1	HOLDER, terminal connector, 2 wire (violet)
	352-0169-08			1	HOLDER, terminal connector, 2 wire (gray)
-20	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--MODULATOR (See A8 Electrical
	- - - - - -			-	Parts List)
	- - - - - -			-	circuit board assembly includes:
-21	131-0589-00			43	TERMINAL, pin, 0.46 inch long
	131-0608-00			10	TERMINAL, pin, 0.365 inch long
	214-0506-00			2	TERMINAL, pin, 0.375 inch long
-22	136-0241-00			2	SOCKET, integrated circuit, 10 pin
-23	136-0252-04			87	SOCKET, pin connector
-24	136-0269-00			1	SOCKET, integrated circuit, 14 pin
-25	200-0715-00			1	COVER, transistor, temperature stabilizer
-26	214-0579-00			5	TERMINAL, test point
-27	337-1417-00			1	SHIELD, electrical
-28	337-1755-00			1	SHIELD, electrical
-29	352-0134-00			2	HOLDER, toroid
-30	131-0707-00			8	CONNECTOR, terminal
-31	352-0169-03			1	HOLDER, terminal connector, 2 wire (orange)
	352-0169-05			1	HOLDER, terminal connector, 2 wire (green)
-32	352-0176-00			1	HOLDER, terminal connector, 2 + 2 wire (black)
-33	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--VIT FULL FIELD (See A4
	- - - - - -			-	Electrical Parts List)
	- - - - - -			-	circuit board assembly includes:
-34	131-0589-00			90	TERMINAL, pin, 0.46 inch long
	131-0608-00			187	TERMINAL, pin, 0.365 inch long
-35	136-0252-04			48	SOCKET, pin connector
-36	136-0269-00			18	SOCKET, integrated circuit, 14 pin
-37	131-0707-00			34	CONNECTOR, terminal

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
2-38	352-0169-00			2		HOLDER, terminal connector, 2 wire (black)
	352-0169-01			3		HOLDER, terminal connector, 2 wire (brown)
	352-0169-02			3		HOLDER, terminal connector, 2 wire (red)
	352-0169-03			2		HOLDER, terminal connector, 2 wire (orange)
	352-0169-04			2		HOLDER, terminal connector, 2 wire (yellow)
	352-0169-05			2		HOLDER, terminal connector, 2 wire (green)
	352-0169-06			3		HOLDER, terminal connector, 2 wire (blue)
-39	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--COLOR BAR (See A3 Electrical
	- - - - - -			-		Parts List)
	- - - - - -			-		circuit board assembly includes:
-40	131-0608-00			96		TERMINAL, pin, 0.365 inch long
	131-0589-00			8		TERMINAL, pin, 0.46 inch long
-41	136-0252-04			102		SOCKET, pin connector
-42	136-0260-01			2		SOCKET, integrated circuit, 16 pin
-43	136-0269-00			20		SOCKET, integrated circuit, 14 pin
-44	214-0579-00			4		TERMINAL, test point
-45	131-0707-00			14		CONNECTOR, terminal
-46	352-0169-00			2		HOLDER, terminal connector, 2 wire (black)
	352-0169-06			1		HOLDER, terminal connector, 2 wire (blue)
	352-0169-09			1		HOLDER, terminal connector, 2 wire (white)
-47	352-0177-00			1		HOLDER, terminal connector, 3 + 3 wire (black)
-48	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--HORIZ TIMING (See A2
	- - - - - -			-		Electrical Parts List)
	- - - - - -			-		circuit board assembly includes:
-49	131-0608-00			445		TERMINAL, pin, 0.365 inch long
-50	136-0252-04			48		SOCKET, pin terminal
-51	136-0260-01			1		SOCKET, integrated circuit, 16 pin
-52	136-0269-00			19		SOCKET, integrated circuit, 14 pin
-53	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--VIT INSERTION (See A0
	- - - - - -			-		Electrical Parts List)
	- - - - - -			-		circuit board assembly includes:
-54	131-0566-00			1		LINK, terminal connecting
-55	131-0589-00			66		TERMINAL, pin, 0.46 inch long
	131-0608-00			6		TERMINAL, pin, 0.365 inch long
-56	136-0235-00			1		SOCKET, transistor, 6 pin
-57	136-0252-04			96		SOCKET, pin connector
-58	136-0260-01			2		SOCKET, integrated circuit, 16 pin
-59	214-0579-00			7		TERMINAL, test point
-60	337-1456-00			1		SHIELD, electrical
-61	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--VERTICAL COUNTER (S A1
	- - - - - -			-		Electrical Parts List)
	- - - - - -			-		circuit board assembly includes:
-62	131-0589-00			43		TERMINAL, pin, 0.46 inch long
-63	131-0998-00			5		BUSS BAR, 9-terminal, 0.375 x 8.132 inches long
-64	136-0252-04			54		SOCKET, pin terminal
-65	136-0269-00			18		SOCKET, integrated circuit, 14 pin
-66	214-0579-00			16		TERMINAL, test point
-67	- - - - - -			1		CIRCUIT BOARD ASSEMBLY--SUBCARRIER SYNC (See A9
	- - - - - -			-		Electrical Parts List)
	- - - - - -			-		circuit board assembly includes:
-68	131-0589-00			78		TERMINAL, pin, 0.46 inch long
	131-0608-00			9		TERMINAL, pin, 0.365 inch long
-69	136-0252-04			110		SOCKET, pin terminal
-70	136-0269-00			7		SOCKET, integrated circuit, 14 pin
-71	214-0579-00			1		TERMINAL, test point
-72	131-0707-00			6		CONNECTOR, terminal
-73	352-0169-02			3		HOLDER, terminal connector, 2 wire (red)

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-74	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--GEN LOCK (See A5 Electrical
	- - - - - -			-	Parts List)
	- - - - - -			-	circuit board assembly includes:
-75	131-0589-00			20	TERMINAL, pin 0.46 inch long
	131-0608-00			3	TERMINAL, pin, 0.365 inch long
-76	136-0252-04			198	SOCKET, pin connector
	136-0234-00			2	RECEPTACLE, electrical
-77	214-0579-00			16	TERMINAL, test point
-78	337-1417-00			1	SHIELD, electrical
-79	352-0096-00			1	HOLDER, crystal
-80	131-0707-00			2	CONNECTOR, terminal
-81	352-0169-06			1	HOLDER, terminal connector, 2 wire (blue)
	- - - - - -			-	mounting hardware: (not included w/circuit board assy)
-82	211-0116-00			4	SCREW, sems, 4-40 x 0.312 inch, PHB
-83	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--POWER SUPPLY (See A10
	- - - - - -			-	Electrical Parts List)
	- - - - - -			-	circuit board assembly includes:
-84	131-0589-00			57	TERMINAL, pin, 0.46 inch long
-85	136-0252-04			36	SOCKET, pin connector
-86	214-0579-00			4	TERMINAL, test point
	- - - - - -			-	mounting hardware: (not included w/circuit board assy)
-87	211-0116-00			2	SCREW, sems, 4-40 x 0.312 inch, PHB
-88	- - - - - -			1	CIRCUIT BOARD ASSEMBLY--RELAY (See A11 Electrical
	- - - - - -			-	Parts List)
	- - - - - -			-	circuit board assembly includes:
-89	131-0589-00			8	TERMINAL, pin, 0.46 inch long
-90	136-0252-04			8	SOCKET, pin connector
-91	200-0762-00			1	COVER, line voltage selector
	- - - - - -			-	cover includes:
-92	352-0102-00			2	FUSEHOLDER
	- - - - - -			-	mounting hardware for each: (not included w/fuseholder)
-93	213-0088-00			2	SCREW, thread forming, 4-40 x 0.25 inch, PHS
-94	204-0279-00			1	BODY, line voltage selector
	- - - - - -			-	mounting hardware: (not included w/body)
-95	210-0407-00			2	NUT, hex., 6-32 x 0.25 inch
-96	210-0006-00			2	WASHER, lock, internal, 0.146 ID x 0.283 inch OD
-97	131-0325-00			1	CONNECTOR, 24 pin, male
-98	200-0918-03			1	COVER, transistor
	- - - - - -			-	mounting hardware: (not included w/cover)
-99	211-0008-00			4	SCREW, 4-40 x 0.25 inch, PHS
-100	131-0126-00			12	CONNECTOR, receptacle, BNC, w/hardware
	- - - - - -			-	mounting hardware for each: (not included w/connector)
-101	210-0241-00			12	LUG, terminal, 0.515 ID x 0.625 inch OD, SE

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-102	131-0126-00			1	CONNECTOR, receptacle, BNC, w/hardware
-103	260-0583-01			1	SWITCH, slide--SYNC SOURCE
	- - - - - -			-	mounting hardware: (not included w/switch)
-104	211-0022-00			2	SCREW, 2-56 x 0.188 inch, PHS
	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-105	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-106	- - - - - -			2	TRANSISTOR (See Q9035, Q9055 Electrical Parts List)
	- - - - - -			-	mounting hardware for each: (not included w/transistor)
-107	211-0510-00			2	SCREW, 6-32 x 0.375 inch, PHS
-108	386-0978-00			1	PLATE, insulator
-109	210-0975-00			2	WASHER, plastic, shouldered, 0.14 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.15 ID x 0.375 inch OD
-110	210-0202-00			1	LUG, solder, SE #6
-111	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-112	- - - - - -			1	TRANSISTOR (See Q9085 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/transistor)
-113	211-0510-00			2	SCREW, 6-32 x 0.375 inch, PHS
-114	386-0143-00			1	PLATE, insulator
-115	210-0935-00			2	WASHER, fiber, shouldered, 0.14 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.15 ID x 0.375 inch OD
-116	210-0202-00			1	LUG, solder, SE #6
-117	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-118	131-0324-00			1	CONNECTOR, 24 pin, female
	- - - - - -			-	mounting hardware: (not included w/connector)
-119	211-0062-00			2	SCREW, 2-56 x 0.188 inch, PHS
-120	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-121	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-122	- - - - - -			1	LINE FILTER (See FL9201 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/line filter)
-123	211-0507-00			2	SCREW, 6-32 x 0.312 inch, PHS
-124	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-125	407-0556-00			1	BRACKET, capacitor
	- - - - - -			-	mounting hardware: (not included w/bracket)
-126	211-0507-00			4	SCREW, 6-32 x 0.312 inch, PHS
-127	210-0457-00			4	NUT, keps, 6-32 x 0.312 inch
-128	200-0293-00			1	COVER, capacitor, 1.365 ID x 2.562 inches long
-129	200-0538-00			1	COVER, capacitor, 1.365 ID x 1.644 inches long

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
2-130	- - - - - -			2	CAPACITOR (See C9042 & C9061 Electrical Parts List)
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
-131	211-0558-00			2	SCREW, 6-32 x 0.75 inch, HHS
-132	432-0048-00			1	BASE, capacitor mounting
-133	386-0254-00			1	PLATE, fiber, large
-134	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-135	386-1487-00			1	SUPPORT, bracket
	- - - - - -			-	mounting hardware: (not included w/bracket)
-136	211-0507-00			4	SCREW, 6-32 x 0.312 inch, PHS
	210-0202-00			1	LUG, solder, SE #6
-137	210-0457-00			4	NUT, keps, 6-32 x 0.312 inch
-138	386-1986-00			1	PANEL, rear
-139	441-0892-00			1	CHASSIS
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0504-00			2	SCREW, 6-32 x 0.25 inch, PHS (not shown)
	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch (not shown)
-140	344-0133-00			48	CLIP, circuit board
	- - - - - -			-	mounting hardware for each: (not included w/clip)
-141	213-0138-00			1	SCREW, thread forming, 6-24 x 0.188 inch, PHS
-142	- - - - - -			1	TRANSFORMER (See T9001 Electrical Parts List)
	- - - - - -			-	mounting hardware: (not included w/transformer)
-143	212-0516-00			4	SCREW, 10-32 x 2 inches, HHS
-144	166-0227-00			4	TUBE, insulating, plastic
-145	210-0812-00			4	WASHER, fiber, 0.188 ID x 0.375 inch OD
	220-0410-00			4	NUT, keps, 10-32 x 0.375 inch (not shown)
-146	343-0320-00			1	CLAMP, loop
	- - - - - -			-	mounting hardware: (not included w/clamp)
-147	211-0507-00			1	SCREW, 6-32 x 0.312 inch, PHS
-148	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-149	348-0063-00			4	GROMMET, plastic, 0.50 inch diameter
-150	348-0050-00			7	GROMMET, plastic, 0.75 inch diameter
-151	348-0064-00			1	GROMMET, plastic, 0.625 inch diameter
-152	386-1532-00			1	SUPPORT, chassis
	- - - - - -			-	mounting hardware: (not included w/support)
-153	210-0457-00			3	NUT, keps, 6-32 x 0.312 inch
-154	214-1169-00			3	PIN, guide, 0.80 inch long

FIGURE 2 CHASSIS (cont)

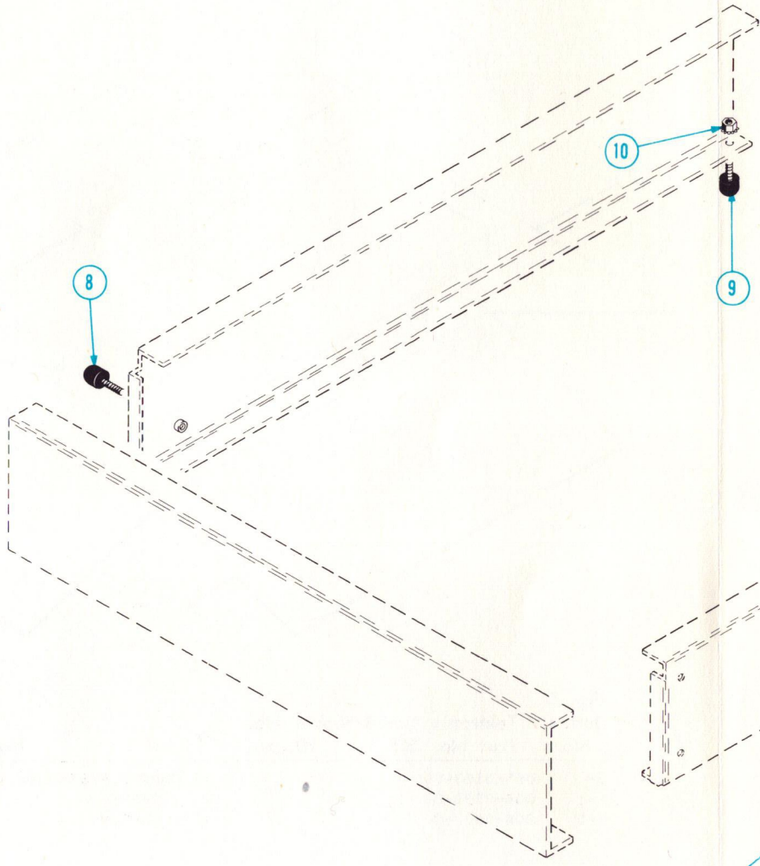
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description
2-155	214-1621-00			7	PIN, guide, 0.74 inch long
	- - - - - -			-	mounting hardware for each: (not included w/pin)
-156	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-157	214-1621-00			8	PIN, guide, 0.74 inch long
	- - - - - -			-	mounting hardware for each: (not included w/pin)
-158	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-159	210-0202-00			1	LUG, solder, SE #6
-160	210-0201-00			7	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
-161	213-0044-00			1	SCREW, thread forming, 5-32 x 0.188 inch, PHS
-162	255-0334-00			ft	PLASTIC CHANNEL, 10.875 inches long
-163	407-0555-00			1	BRACKET
	- - - - - -			-	mounting hardware: (not included w/support)
-164	211-0507-00			4	SCREW, 6-32 x 0.312 inch, PHS
-165	210-0457-00			3	NUT, keps, 6-32 x 0.312 inch
-166	441-1008-00			1	CHASSIS, main
-167	179-1850-00			1	WIRING HARNESS, chassis
	- - - - - -			-	wiring harness includes:
-168	131-0621-00			237	CONNECTOR, terminal
	131-0622-00			41	CONNECTOR, terminal
-169	131-0707-00			140	CONNECTOR, terminal
	131-0708-00			10	CONNECTOR, terminal
	131-0792-00			36	CONNECTOR, terminal
-170	352-0161-00			3	HOLDER, terminal connector, 3 wire (black)
-171	352-0162-00			6	HOLDER, terminal connector, 4 wire (black)
-172	352-0164-00			2	HOLDER, terminal connector, 6 wire (black)
-173	352-0165-00			3	HOLDER, terminal connector, 7 wire (black)
-174	352-0166-00			9	HOLDER, terminal connector, 8 wire (black)
-175	352-0167-00			2	HOLDER, terminal connector, 9 wire (black)
-176	352-0168-00			4	HOLDER, terminal connector, 10 wire (black)
-177	352-0169-00			1	HOLDER, terminal connector, 2 wire (black)
-178	352-0171-00			1	HOLDER, terminal connector, 1 wire (black)
	352-0171-02			1	HOLDER, terminal connector, 1 wire (red)
	352-0171-03			1	HOLDER, terminal connector, 1 wire (orange)
	352-0171-04			1	HOLDER, terminal connector, 1 wire (yellow)
-179	352-0197-00			4	HOLDER, terminal connector, 1 wire (black)
-180	352-0198-00			7	HOLDER, terminal connector, 2 wire (black)
-181	352-0199-00			3	HOLDER, terminal connector, 3 wire (black)
-182	352-0200-00			6	HOLDER, terminal connector, 4 wire (black)
	352-0200-02			1	HOLDER, terminal connector, 4 wire (red)
	352-0200-06			1	HOLDER, terminal connector, 4 wire (blue)
-183	352-0201-00			7	HOLDER, terminal connector, 5 wire (black)

FIGURE 2 CHASSIS (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5 Description
2-184	352-0202-00			8	HOLDER, terminal connector, 6 wire (black)
-185	352-0203-00			4	HOLDER, terminal connector, 7 wire (black)
-186	352-0204-00			6	HOLDER, terminal connector, 8 wire (black)
-187	352-0205-00			5	HOLDER, terminal connector, 9 wire (black)
-188	352-0206-00			14	HOLDER, terminal connector, 10 wire (black)
	179-1687-00			1	WIRING HARNESS, AC, w/connectors
	179-1686-01			1	WIRING HARNESS, coaxial
	- - - - - -			-	wiring harness includes:
	131-0621-00			8	CONNECTOR, terminal
	131-0622-00			10	CONNECTOR, terminal
	131-0792-00			9	CONNECTOR, terminal
-189	352-0163-00			1	HOLDER, terminal connector, 5 wire (black)
	352-0168-00			1	HOLDER, terminal connector, 10 wire (black)
	179-1685-00			1	WIRING HARNESS, power
	- - - - - -			-	wiring harness includes:
	131-0621-00			21	CONNECTOR, terminal
	352-0165-00			2	HOLDER, terminal connector, 7 wire (black)
	352-0167-00			1	HOLDER, terminal connector, 9 wire (black)
	179-1863-00			1	WIRING HARNESS, horizontal timing
	- - - - - -			-	wiring harness includes:
	131-0707-00			132	CONNECTOR, terminal
	352-0164-00			1	HOLDER, terminal connector, 6 wire (black)
	352-0166-00			1	HOLDER, terminal connector, 8 wire (black)
	352-0166-01			1	HOLDER, terminal connector, 8 wire (brown)
	352-0166-02			1	HOLDER, terminal connector, 8 wire (red)
	352-0166-03			1	HOLDER, terminal connector, 8 wire (orange)
	352-0167-00			2	HOLDER, terminal connector, 9 wire (black)
	352-0168-00			1	HOLDER, terminal connector, 10 wire (black)
	352-0169-00			1	HOLDER, terminal connector, 2 wire (black)
	352-0171-00			30	HOLDER, terminal connector, 1 wire (black)
	352-0171-01			17	HOLDER, terminal connector, 1 wire (brown)
	352-0171-02			9	HOLDER, terminal connector, 1 wire (red)
	352-0171-03			6	HOLDER, terminal connector, 1 wire (orange)
	352-0171-04			4	HOLDER, terminal connector, 1 wire (yellow)

FIGURE 3 BENCH MODEL

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	Description 1 2 3 4 5
3-1	124-0216-00			2	STRIP, trim, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
-2	212-0068-00			2	SCREW, 8-32 x 0.312 inch, THS
	386-1663-00			1	PLATE-HANDLE ASSEMBLY
	- - - - - -			-	plate-handle assembly includes:
-3	386-1663-01			1	PLATE, handle mounting
-4	367-0037-00			1	HANDLE
	- - - - - -			-	mounting hardware: (not included w/handle)
-5	212-0506-00			2	SCREW, 10-32 x 0.375 inch, 100° csk, FHS
-6	344-0098-00			2	CLIP
	- - - - - -			-	mounting hardware: (not included w/plate-handle assy)
-7	212-0507-00			2	SCREW, 10-32 x 0.375 inch, PHS
-8	348-0048-00			4	FOOT, rubber
-9	348-0048-00			4	FOOT, rubber
	- - - - - -			-	mounting hardware for each: (not included w/foot)
-10	210-0457-00			4	NUT, keps, 6-32 x 0.312 inch



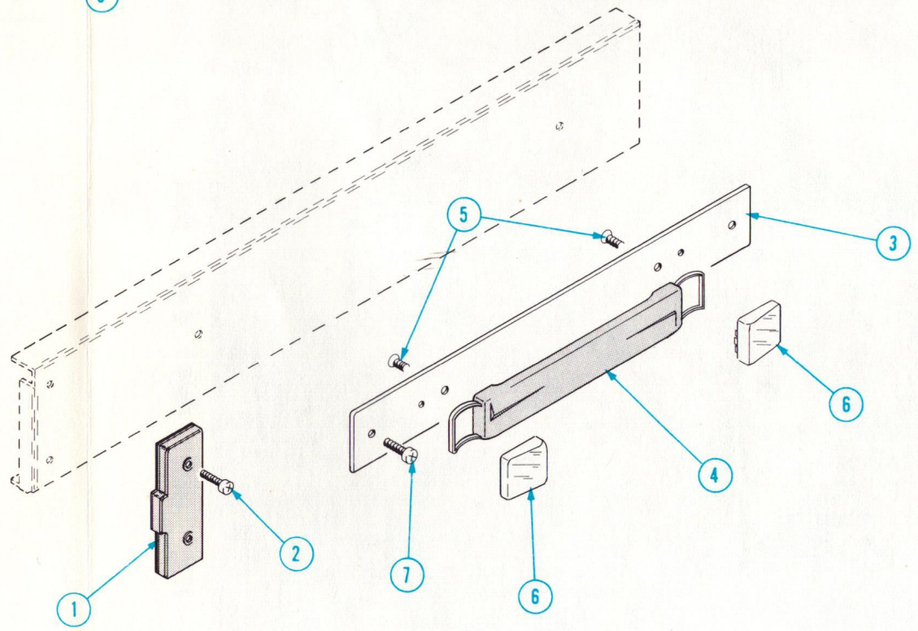


FIG. 3 BENCH MODEL

FIG. 4 ACCESSORIES &
FIG. 5 REPACKAGING

ACCESSORIES

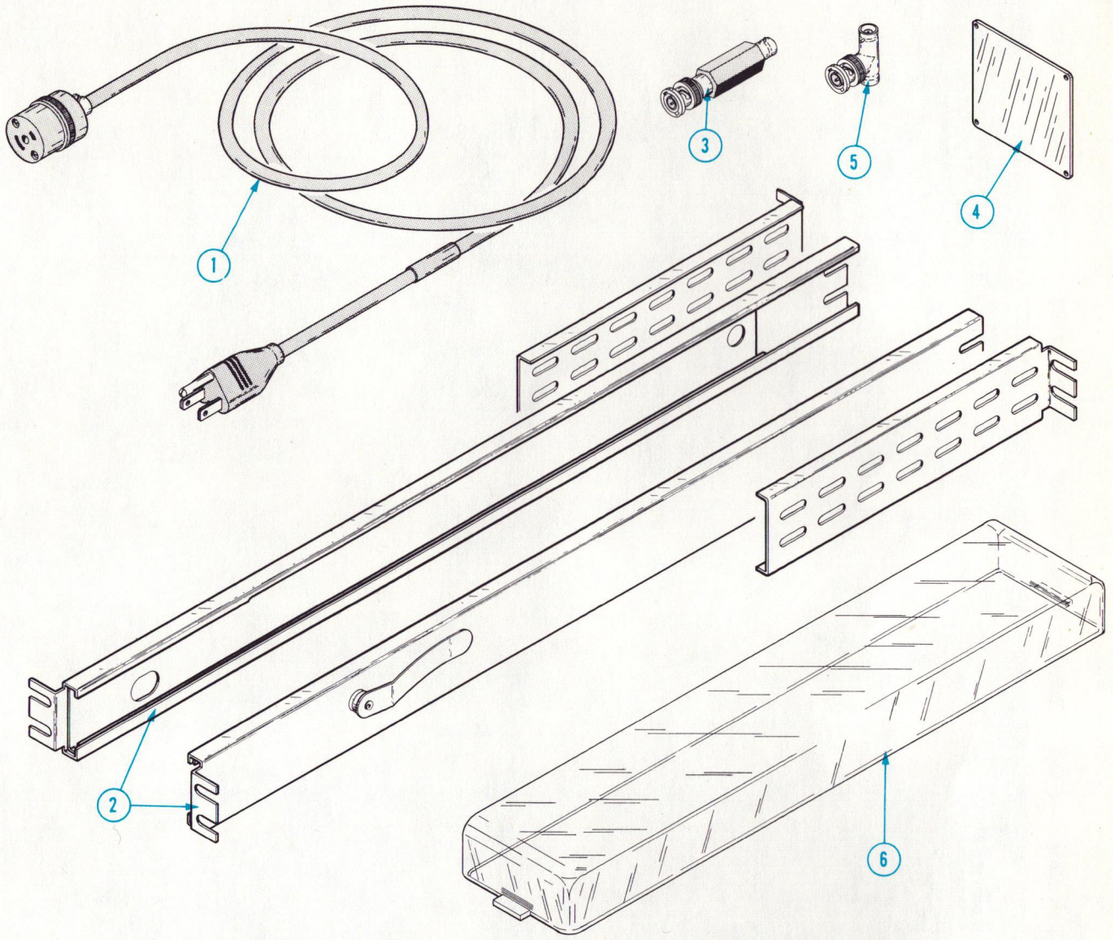


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description
4-1	161-0036-00			1		CABLE ASSY:POWER,3 WIRE,7.50 FEET LONG
-2	351-0195-00			1		TRACK:SLIDE,PAIR(RACKMOUNT ONLY)
-3	011-0103-02			1		TERMINATION:75 OHM,BNC
-4	200-1474-00			1		COVER:FRONT PANEL
-5	103-0030-00			2		ADAPTER:BNC T MALE TO 2 FEMALE
-6	200-1328-00			1		COVER:PROTECTIVE
	070-1374-00			1		MANUAL

REPACKAGING

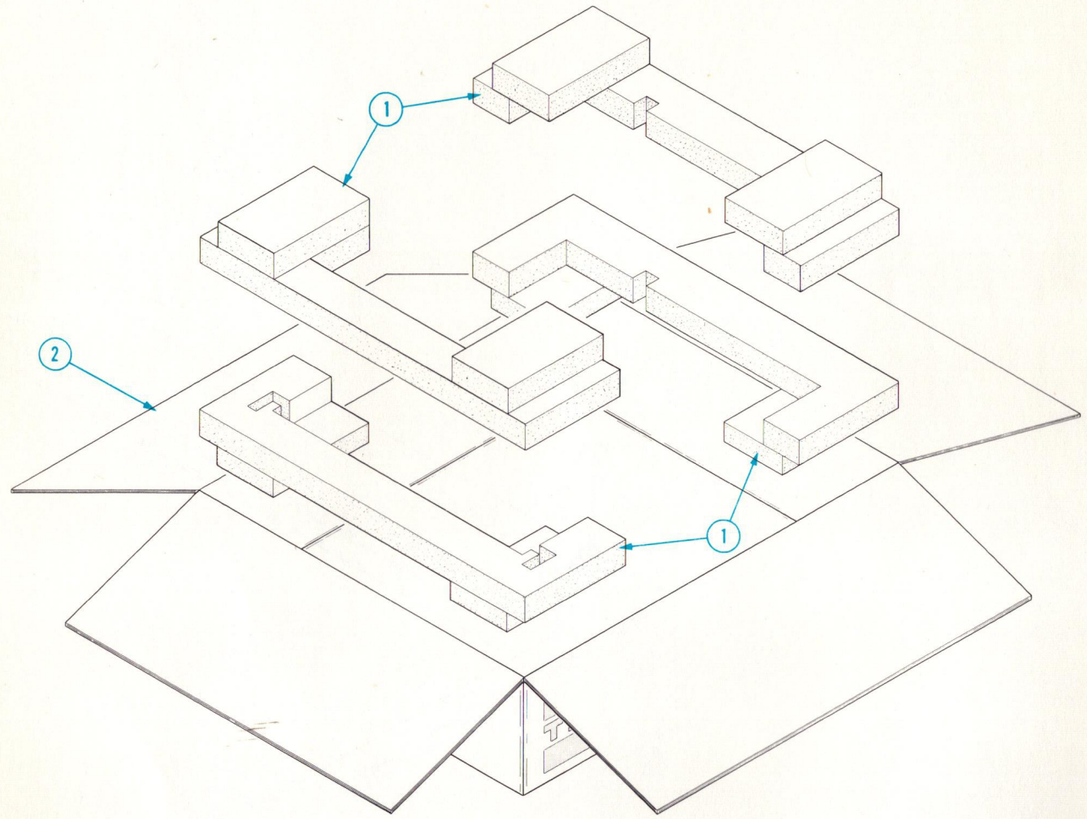


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description
5-	065-0163-00			1		CARTON ASSEMBLY:
-1	004-0291-00			2		. FRAME:
-2	004-0807-00			1		. CARTON:

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

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MANUAL CHANGE INFORMATION

PRODUCT GENERAL

CHANGE REFERENCE S23351

DATE 4-10-75

CHANGE:	DESCRIPTION

POWER CORD CHANGES

The 1974 National Electrical Code permits the use of IEC (International Electrotechnical Commission) power cord color codes. As production permits, we are changing the entire Tektronix product line to comply with IEC power cord color code requirements. As a result, the power cord on Tektronix instruments may conform to either IEC or the older NEC requirements. The change consists of the following:

Conductor	NEC	IEC
Line	Black	Brown
Neutral	White	Light Blue*
Safety Earth	Green w/Yellow Stripe	Green w/Yellow Stripe

*Tinned copper conductor.

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MANUAL CHANGE INFORMATION

PRODUCT 149A

CHANGE REFERENCE C3/574

DATE 5-29-74

CHANGE:	DESCRIPTION

TEXT CORRECTION

TABLE 2-4, Factory Horizontal Programming

ADD: the following:

Signal	Affected Portion	Function	Color Code		Timing	
			Wires	Connector	µSec	Instant
MODULATED PEDESTAL (STOC II)	40 IRE Modulation	Set	9-02	0	22	11
	80 IRE Modulation	Set	9-12	2	36	18
		Reset	9-18	3	48	24
MODULATED PEDESTAL	40 IRE Modulation	Set	9-8	0	16	8
	80 IRE Modulation	Set	9-03	0	24	12
		Reset	9-07	0	32	16
COLOR BARS	White Bar	Clock	9-5	0	10	5
	Yellow Bar	Clock	9-0	0	18	9
	Cyan Bar	Clock	9-03	0	24	12
	Green Bar	Clock	9-06	0	30	15
	Magenta Bar	Clock	9-12	0	36	18
	Red Bar	Clock	9-15	0	42	21
	Blue Bar	Clock	9-18	0	48	24
	Black Bar	Clock	9-25	0	54	27

CHANGE:	DESCRIPTION

DIAGRAM (2)a Relabel connections as shown below:

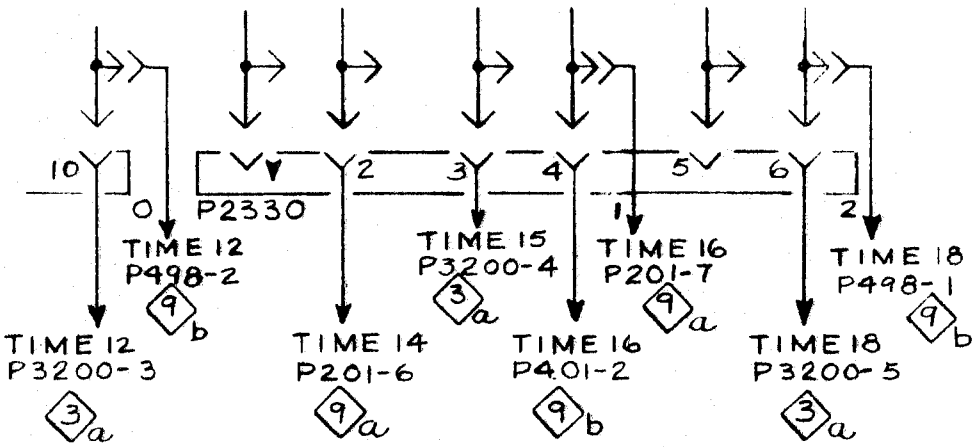

DIAGRAM (3)a

P3200	TIME 18 P2330-7	should read:	TIME 18 P2330-6
P3190	P7101-5	should read:	P7101-8

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MANUAL CHANGE INFORMATION

PRODUCT 149A

CHANGE REFERENCE C4/1074

DATE 10-22-74

CHANGE:	DESCRIPTION

TEXT CORRECTION

Section 4 Maintenance and Calibration, Page 4-11, Step 19.

CHANGE TO READ:

19. SYNC & GEN LOCK

Display the vertical interval of the 149A full-field signal.

Set the PROGRAM CONTROL switch to AUXILIARY to bypass the 149A from the PROGRAM LINE.

Wire P9014 for Local operation. Connect a SPST slide or toggle switch from pin 9 of P9014 to ground. (When this switch is in the ground position, the BLACK BURST INPUT connector becomes the sync source).

Set the external switch to the ground position. The NONSYNCHRONOUS MODE-NO VITS light should be on. There should be no VITS and no VIRS.

Connect the composite sync signal to the BLACK BURST input. The NON-SYNC lamp should extinguish. There should be VITS but no VIRS.

Replace the composite sync signal with a composite video signal (with sync and subcarrier). There should be VITS and VIRS and no signal lights on.

Set the external switch to the open (ungrounded) position. The sync source should now be PROGRAM LINE. Check that signal lights are on and VITS & VIRS are present.

Group 11 - VIRS Sensitivity, Page 4-40, first paragraph.

CHANGE TO READ:

Wire P9014 for Local operation. Connect a SPST slide or toggle switch from pin 9 of P9014 to ground. Connect the composite video signal to the BLACK BURST input. Set the external switch to the ground position. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN. Display line 20 of the PROGRAM LINE OUT signal on the monitor.

CHANGE:	DESCRIPTION

Group 12 - GEN-LOCK, Page 4-41, Step 2., part a.

CHANGE TO READ:

a. Set the external switch to the ground position.

CHECK - Loss of 149A VITS and the VIR signal.

Page 4-42, Step 2., part c.

CHANGE TO READ:

c. Set the external switch to the open (ungrounded) position. Disconnect the BLACK BURST input signal.

CHECK - TP5290 should have about the same peak-to-peak signal gain with the video signal source sync on or off, and with either color bars or modulated staircase.

Group 14 - VITS INSERTION, Page 4-44, Step 2., part a.

CHANGE TO READ:

a. Display the vertical interval of the PROGRAM LINE OUT signal on the monitor. Connect the video signal source composite sync signal to the BLACK BURST input. Set the external switch to the ground position. Connect a cable from the rear-panel FULL FIELD TEST SIGNAL OUT to the PROGRAM LINE IN.

Page 4-46, Step 5., part a.

CHANGE TO READ:

a. Connect the video signal source to the PROGRAM LINE IN. Set the external switch to the open (ungrounded) position. Display the PROGRAM LINE OUT signal on the vectorscope.

CHECK - INSERT SUBCARRIER PHASE control range is approximately 28°; range should be at least 5° on either side of the burst vector.

CHANGE:	DESCRIPTION

Group 14 - VITS INSERTION, Page 4-47, Step 6., part c.

CHANGE TO READ:

c. Connect the video signal source to the BLACK BURST input. Set the external switch to the ground position. Connect the FULL FIELD TEST signal to the PROGRAM LINE IN. Set the FULL FIELD SIG switch to MULTIBURST.

Page 4-47, Step 7., part a.

CHANGE TO READ:

a. Connect the video signal source to the PROGRAM LINE IN. Set the external switch to the open (ungrounded) position. Display the PROGRAM OUT signal on the vectorscope.

Page 4-47, Step 8., part a.

CHANGE TO READ:

a. Connect the video signal source to the BLACK BURST input. Set the external switch to the ground position. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN.

Group 16 - OPTIONAL CHECKS, Page 4-50, Step 3., part a.

CHANGE TO READ:

a. Connect the composite video from the video signal source to the BLACK BURST input. Set the external switch to the ground position. Externally trigger the test oscilloscope from composite sync.

CHANGE:	DESCRIPTION

Group 16 - OPTIONAL CHECKS, Page 4-50, Step 4., part a.

CHANGE TO READ:

a. Connect the rear-panel FULL FIELD TEST signal to the PROGRAM LINE IN. Connect the video signal source composite video to the BLACK BURST input and loop-through to the EXT VITS IN connector. Set the external switch to the ground position. Set the video signal source to insert a modulated staircase VITS on line 17 of field 2; program the 149A for this external VIT signal. Display the vertical interval of the PROGRAM LINE OUT signal on the monitor.

Page 4-51, Step 7., part a.

CHANGE TO READ:

a. Setup

Connect the video signal source composite video to the BLACK BURST input. Set the external switch to the ground position. (There is no input to the PROGRAM LINE.) Display the PROGRAM LINE OUT signal on the test oscilloscope.

SCHEMATIC CORRECTION

MODULATOR 

CHANGE:

BURST GAIN adjustment

TO READ:

BURST AMPLITUDE

R8705

10 k

R149A EFF SN B050000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

C8031	290-0522-00	1 μF, Elect., 50 V, 20%
R406	321-0308-00	15.8 kΩ, 1/8 W, 1%
R411	321-0307-00	15.4 kΩ, 1/8 W, 1%
R8785	321-0195-00	1.05 kΩ, 1/8 W, 1%

ADD:

C8789	281-0510-00	22 pF, Cer, 500 V

Add C8789 parallel to CR8789 located on Diagram 8

149A EFF SN B060000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

REMOVE:

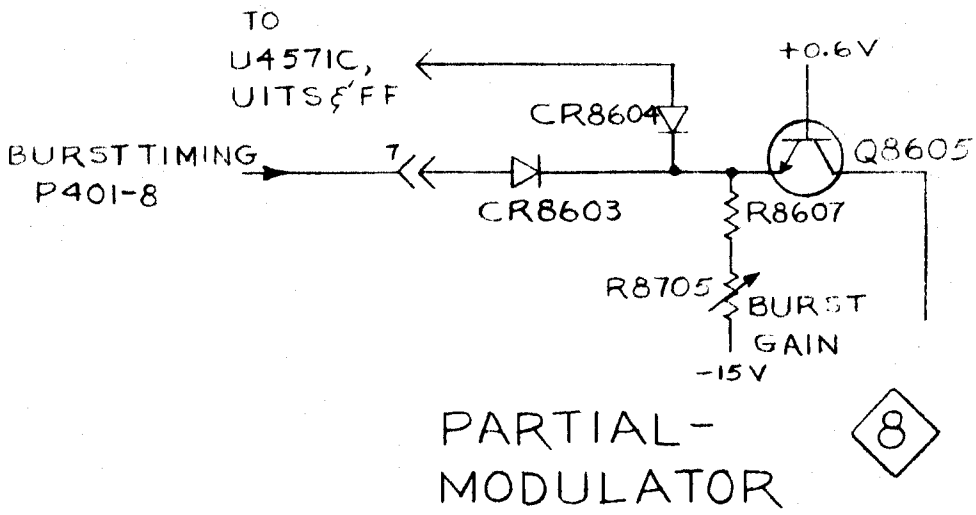
CR4572	152-0141-02	Silicon, replaceable by 1N4152

CHANGE TO:

R7181	315-0393-00	39 kΩ, 1/4 W, 5%

ADD:

CR8604	152-0185-00	Silicon, selected from 1N4152 or 1N3605



PARTIAL-
MODULATOR

8

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MANUAL CHANGE INFORMATION

PRODUCT 147A/R & 149A/R

CHANGE REFERENCE M22,936

DATE 11-4-74

CHANGE:	DESCRIPTION

EFF SN B121390-up (147A/R)

EFF SN B070830-up (149A/R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

CHANGE TO:

C5040	283-0167-00	0.1 μF, Cer, 200 V, 10%